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VOLUME 15 NUMBER 6

AMERICAN JOURNAL

OF

DISEASES OF CHILDREN

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JUNE, 1918

PUBLISHERS
AMERICAN MEDICAL ASSOCIATION
CHICAGO, ILL.

ENTERED AS SECOND-CLASS MATTER, JANUARY 4, 1911, AT THE POST-OFFICE AT CHICAGO, ILLINOIS, UNDER ACT OF CONGRESS OF MARCH 3, 1879

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American Journal of Diseases of Children

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METHODS USED IN A CLASS FOR UNDERNOURISHED CHILDREN *

CHARLES HENDEE SMITH, M.D.
NEW YORK

During the past few years attention has been repeatedly called to the fact that a large number of children in this country are undernourished. That this is true has been shown by the reports of school inspectors and by several different surveys made by other agencies. These have been summarized recently by Baker[1] and by the report of the Public Health Committee of the New York Academy of Medicine.[2] The exact amount of this malnutrition is estimated differently by various observers, and this is partly due to the fact that there is no accurate or standard scale by which to measure the nutrition of the child. In some of the surveys no weights were taken, but the nutrition was merely left to the judgment of the observer. Nevertheless, there is no doubt that the amount of malnutrition is not inconsiderable, and that it promises to mount to an alarming degree unless its existence is recognized and measures are taken to combat it. The various estimates range from 10 to 30 per cent. of distinctly undernourished children in the public schools of New York City. Even at the lowest figure this means 100,000 children.

Any physician who has worked in a children's outpatient department will readily grant that this problem has not been recognized or met in the past. The undernourished child who has no interesting signs of organic disease has had scant attention. He has been put aside with a diagnosis of "anemia" or "malnutrition" or perhaps has been called "pretuberculous." He may have been given an iron tonic or cod liver oil at his first visit, but in the vast majority of cases no effort has been made to ascertain the underlying reason for his undernourished condition, or to induce him to return for subsequent observation or treatment.

* Submitted for publication April 10, 1918.
* Presented before the Pediatric Section of the New York Academy of Medicine, March 14, 1918.

1. Baker, S. J.: New York Med. Jour., Feb. 16, 1918, p. 289.
2. Report of the Public Health Committee, Med. Rec., New York, Feb. 23, 1918, p. 311.

Nov. 1, 1916, a Nutrition Class was started in the Outpatient Department of Bellevue Hospital as an experiment to determine how much could be done to improve the nutrition of undernourished children when handled in large numbers. It is well known that much can be done for individual children who are under-weight if their lives can be properly regulated, and that groups of children can be made to gain at much more than the average rate in institutions, camps and so forth. It is a comparatively easy matter to make any group of children gain rapidly when their diet and habits can be completely controlled. But controlled groups in institutions are of necessity small, and the children who are made to gain while under control are very apt to lose much of the accumulated weight when they return to their homes and to the former insufficient diet and unhygienic mode of life. Some plan must be devised by which the malnutrition problem can be attacked on a large scale, and which will strike at the very root of the trouble, that is, the daily life of the child in his own home.

The class system offers one of the ways in which this may be done. It has long been used for tuberculosis in adults and children and has given admirable results. The class plan as applied to undernourished children, to patients with heart disease, and to other groups, has nothing new in principle. Each group of patients studied has its own problems, however, and new methods must be worked out for each.

The nutrition class was planned as one of a number of classes for the treatment and study of special conditions at the time of the reorganization of the Children's Medical Division. The Health Department loaned one of its school nurses through the association for the Improvement of the Condition of the Poor, and this nurse has acted as social worker for the class since its beginning. The Association for the Improvemnet of the Condition of the Poor through its Bureau of Child Welfare, also rendered assistance in compiling and studying the statistics obtained during the first months of the work.

The methods which are used in this class have been worked out in the children's tuberculosis class and other classes at the Vanderbilt Clinic, to which have been added valuable methods obtained from the papers of Emerson[3] of Boston and from other sources. To Emerson must be given great credit, since he has been the pioneer in calling attention to the existence of large numbers of delicate children, and also to the value of the class method in treating them. The conditions of the work in the Bellevue Hospital Class under which one physician is compelled to take care of from forty to sixty children in an afternoon have necessitated the adoption of a great many short-cuts and time-

3. Emerson, W. R. P.: Boston Med. and Surg. Jour., 1910, **163,** 326; Ibid., Pediatrics, 1910, **22,** No. 9.

saving methods which are absolutely essential when large numbers must be handled by one man. It was planned originally to have several physicians at work in the class, but the entrance of this country into the war so reduced the staff that the work has been done by one or two men.[4] Volunteer women workers have assisted much in the conduct of the class. Without their aid it would be impossible to handle the large numbers who have attended.

The patients in the nutrition class have come from several sources. The markedly undernourished children who apply to the outpatient department for treatment for any condition whatever, and also the undernourished children discharged from the wards, are referred to the nutrition class. The school nurses from the neighboring schools have sent a large number of children and they have also come from agencies all over the city.

Every child who has applied for admission to the class has been accepted if he has been 5 pounds or more *underweight for his age*. A large number of patients have been referred who were actually overweight, simply because they looked a little pale or thin. These children have all been examined and advised, but have not been enrolled in the class.

There have been enrolled as members of the class		290 children
Discharged on account of refusal to attend	77	
Moved away	14	
Not found	6	
Transferred to tuberculosis class	3	
Working	2	
	—	102 children
Remaining regular in attendance		188 children

The children return at varying intervals, from once a week to once a month. The average attendance is from thirty-five to forty, and since the class is held twice a week about one third of the children are seen each week. The follow up work has all been done by one social worker, and it is manifestly impossible properly to follow every case as fully as is desirable. At least one visit has been made to each home, and the subsequent visits have been made on families where the need seemed greatest. A follow up card index is used, and postals are sent to ask mothers to return, when their visits are irregular. The postal is followed by a visit if it brings no response.

4. Dr. H. L. Bibby, who is now in France, and Dr. L. C. Schroeder have assisted during part of the past year.

We have made it a rule that the parent or some adult member of the family must come to the class for the first few visits so that advice and instructions can be given to a responsible person. After the first visit most of the children have come alone, because it does not seem fair to exclude a child simply because his mother is unable to come every week. It would be much better, of course, to have the parents attend regularly, and many of them have done so from choice, but so many of the mothers are kept at home by the other children, by housework or by actual employment, that the percentage of attendance of mothers has to be necessarily quite low. In this regard, as in many others, we have deliberately fitted the plan of the class to the conditions which exist and have not laid down any hard and fast rule which would exclude many children who need treatment. The children whose parents have attended regularly have naturally done better than those who have come alone, as the advice given to a child who comes alone may or may not be transmitted to the parent in the form in which it is given. It is also perfectly futile to tell a child he must not drink coffee and must take milk and cereal when his answer is that his mother gives him only coffee and buns, but in many instances by repeatedly urging the child to ask his mother for the right food we have attained the end for which we have aimed, even though the mother was not able to come to the class.

The Routine.—Each child has had a fairly complete history on admission to the class on the printed history form used in the department. This includes a careful family history, past history, and analysis of the child's daily habits: time of going to bed, getting up, sleep, open window at night, amount of time outdoors, number of hours in school, bowel habits, quality and quantity of food taken at each meal and between meals, the amount of tea, coffee, beer, candy, etc. The present history is added, including the source from which the patient is sent, and the reason for which the child is admitted to the class, and any symptoms which he may present at the time. A complete physical examination is made of every child, including his weight and height. A von Pirquet test is made at the first or subsequent visit. The blood and urine are examined when possible. The social worker gets the social service facts either at the first visit, or at her first visit to the patient's home, and these facts are entered on the medical history by means of a rubber stamp. Everything of importance from the physical and economic standpoints is thus noted on the medical history. It has too long been the custom to have social service data carefully

filed on a separate card in another cabinet and often in another building from the medical record where they are absolutely unavailable for the doctor's use.

The rubber stamp used for the social data bears the following:

SOCIAL SERVICE. FIRST REPORT, BY

Living, Health, Alcoholic, Working, Occupation, Wages,

FATHER. **Family Income**

MOTHER. **Intelligent? Responsive? Clean?**

CHILDREN. **Number** **Ages** **Number Working**

HOME. **Number Rooms** **Number Dark** **Rent**

Sanitary Condition

FOOD. **Sufficient Yes No** **Cooking, Good, Fair, Bad**

NEEDS

ADVICE AND ASSISTANCE

Besides the foregoing the worker adds any other facts of interest which she collects. After later visits she makes brief notes or fills out the later report stamp:

SOCIAL SERVICE LATER REPORT, BY

HOME, Improved, Unimproved

FOOD, Sufficient Yes No Cooking, Good Fair Bad

PATIENT T. P. R.

SYMPTOMS

TREATMENT AND ADVICE

The *general plan* which has been kept in mind has been to make a careful diagnosis, to correct remediable physical defects, to determine and correct any economic factors that have a bearing on the case, and to try to improve the hygiene and diet of the child by every possible means.

At the first visit an attempt is made to pick out the important elements which bear on the child's malnutrition. A short talk is given to each mother and child on the errors of hygiene of which that child is guilty. The child's daily life is gone over carefully; the importance of early hours, sufficient sleep, cleanliness, regular bowel movement, eating slowly, and above all of eating the proper kind and sufficient amount of food, is emphasized as strongly as possible. If there are any decayed teeth the child is referred to the dentist, or taken to him by the nurse. If the tonsils or adenoids are giving symptoms or if they are much enlarged, operation is advised provided the child's

general condition warrants it. When the nutrition and general condition are extremely bad it is often better to wait a few months and try to make the child more fit for an operation. There is nearly always a loss of weight after a tonsillectomy and if a child is operated on when he is in very bad condition the recovery of the additional loss in weight is very slow. It is also important to keep the child in bed for at least five days after tonsillectomy, or the loss in weight may be excessive.

CHILDREN'S MEDICAL DIVISION — **BELLEVUE HOSPITAL** — OUT PATIENT DEPARTMENT

PROPER FOOD FOR CHILDREN OF SCHOOL AGE

			CHEAPER Bulk Cereals	MORE EXPENSIVE Cereals in packages	MOST EXPENSIVE Dry Cereals*
BREAKFAST					
1. CEREAL	2 to 6 tablespoonfuls	*Cook 3 hours night before, in double boiler, or fireless cooker*	Oatmeal, Cornmeal, Hominy, Rice, Farina.	Wheatena, Malt Breakfast Food, Cream of Wheat, Pettijohn's	Shredded Wheat, Force, Corn Flakes, Puffed Rice
2. MILK	1 cup		(Milk gives the most food for the money even when very high priced)		
or COCOA	1 cup	*1 teaspoonful to a cup (half milk, half water)*			
3. BREAD AND BUTTER	1 to 2 slices	*(stale or toasted)*	Whole Wheat, Graham or Corn Bread	White Bread	Rolls
			Nut Margarine or Oleomargarine are just as nourishing as Butter which costs about twice as much		
4. EGG		*(soft boiled or poached or scrambled with milk)*			
5. FRUIT		*Cook 2 - 3 hours without sugar. Soak over night if very dry.*	Cooked Apples, Stewed Prunes, Stewed Dried Peaches, Stewed Dried Apples	Oranges or Grapefruit	
DINNER					
1. SOUP	1 bowl		Vegetable soup - made from Peas, Split Peas, Beans, Lentils (from list given above)		Meat Soups if given should be thickened with rice or barley.
or CEREAL	2 to 4 tablespoonfuls				
or EGG		*(soft boiled or poached or scrambled with milk)*			
2. MILK	1 to 2 cups				
3. BREAD AND BUTTER	1 to 2 slices	*(stale or toasted)*	Whole Wheat, Graham or Corn	White Bread	
4. COOKED FRUIT	2 to 3 tablespoonfuls		Apple Sauce, Baked or Stewed Apples, Stewed Prunes, Stewed Dried Peaches	Stewed Dried Apricots, Baked Bananas	Fresh fruit, peaches, pears, oranges
SUPPER					
1. MEAT	a small piece about 2 ounces	*Stew, boil, roast or broil Do Not Fry!*	Lamb Stew, Beef Stew, Fish, Cod, Flounder, Haddock, fresh Halibut	Chopped Beef, Chicken	Roast Beef, Beefsteak, Roast Lamb, Lamb Chop
or VEGETABLE SOUP	1 bowl		made from Peas, Split Peas, Beans, Lentils or any of fresh vegetables		Broth or Meat Soup with rice or barley
2. VEGETABLES					
Fresh Vegetables	2 to 4 tablespoonfuls	*Put into small amount of boiling salted water cook until tender, drain off all the water.*	Spinach, Chard, Beet Tops, Greens, Carrots, Beets, Boiled Onions, Lima Beans, (cook 3 hours)	Peas, String Beans, Squash, Stewed Celery, Knob Celery	Cauliflower, Oyster Plant, Parsnips
and					
Starchy Vegetables	2 tablespoonfuls	*boiled, baked, mashed Do Not Fry!*	Potatoes, Sweet Potatoes, Rice, Hominy, Spaghetti, Macaroni		
3. BREAD AND BUTTER	1 to 2 slices	*(stale or toasted)*	Whole Wheat, Graham or Corn Bread	White Bread	
4. DESSERT	1 to 2 tablespoonfuls		Rice, Tapioca or Bread Pudding, Cornmeal or Cereal puddings, Cooked fruit, [from list given above]	Junket, Custard, Cornstarch Pudding	Gelatine, Ice Cream

DO NOT GIVE

1. TEA, COFFEE, soda water, beer, wine, whiskey, cider.
2. Fried food of any kind.
3. Pork, veal, kidneys, greasy stews, gravy made from drippings or grease.
4. Corn, cabbage, cucumbers.
5. Fresh breads, buns, cake, pie, fried cakes, rich puddings.
6. Nuts, raisins, berries, cherries.
7. Candy, jelly, sweet preserves.
8. Too much milk: one quart a day at most is enough for any child. Every child needs at least one pint a day.

RULES FOR EATING.

Give no food between meals unless ordered by doctor. If a child is very hungry after school give him a piece of bread and butter, NOT cake or fruit.
Make every child eat slowly and chew his food well and not wash it down with water or milk.
Allow child to drink only one glass of water with each meal.
Urge children to drink water between meals but not at bedtime.
Make every child wash his face and hands before meals.
SERVE FOOD WARM and WELL COOKED on clean dishes and a clean table.
KEEP FLIES AWAY FROM FOOD. One fly can give typhoid or summer complaint.
BUY ONLY BOTTLED MILK, and ALWAYS KEEP ON THE ICE.

Fig. 1.—Reproduction of diet list (reduced).

A printed slip with directions as to the general care of the child and a diet list (Fig. 1) are given to every mother, and these are explained carefully in an effort to prevent her from thinking them unimportant pieces of paper. The diet list has been rewritten several times in collaboration with the director and the attending physicians of the Children's Medical Division, and with the dietitian of the Association for Improving the Condition of the Poor. The first lists used were simply an ideal diet for a child, but it was found that the expensive foods which occupied the most prominent place on the lists dis-

couraged the mothers from trying to pick out a dietary within their means. In the revised lists the various foods are sorted according to their relative cheapness. In the first column (Fig. 1) appear the articles of food to be taken at each meal; in the second the amounts of each; the third column gives some simple cooking directions. The various articles of food are then arranged in order of their cheapness and importance. Thus, it is seen that milk is put in the fourth column, not because it is a cheap food, but because it really gives more food for the money than many apparently cheaper foods. White bread is put among the more expensive foods because it has less of the desirable elements than whole wheat and graham, although it costs about the same. Since this diet list has been in use it has been found that the parents respond to it much more readily than to the earlier one.

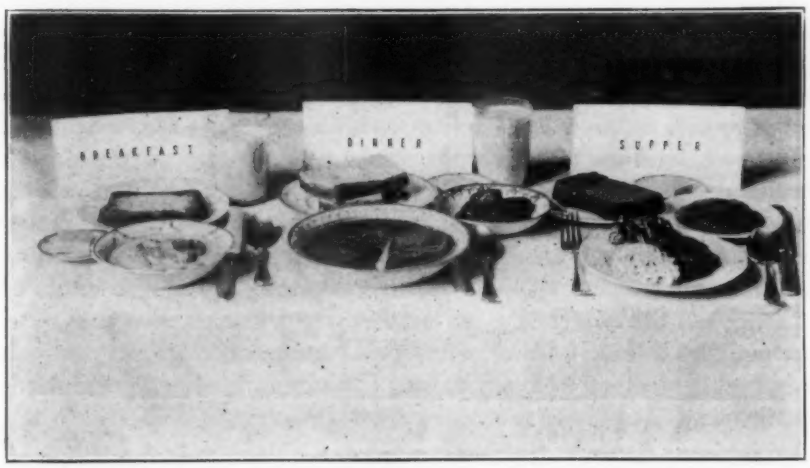


Fig. 2.—Exhibit of artificial foods, showing the way in which three meals are placed on the table. This arrangement is varied each day.

At the first visit the attention of the mother and child is called to the *food exhibit,* as an aid to impressing on their minds the elements of a proper diet. This exhibit differs in important respects from those in common use. Most of these have been composed of quantities of food which represent hundred calory portions, or other units, and merely show the relative value of the various foods from the energy standpoint. They do not show the relative desirability of foods from other than this point of view. For example, a plate containing three or four large tablespoonfuls of vegetable shows that vegetables are relatively poor in energy-yielding substances, but there is danger that an ignorant mother may think a child should eat four or five large tablespoons of a green vegetable and only a comparatively small quantity of cereals or other food high in caloric value.

The food exhibit which we use is based on the day's total ration. Three meals are laid out each day: breakfast, dinner and supper. The mother and the child can both then see at a glance the total amount of food needed in the day, and also the exact composition of each meal. These meals are laid out as if ready to serve, with dishes, knife, fork and spoon, and each meal is properly labeled (Fig. 2). The breakfast usually consists of a dish of cereal with milk or a cup of cocoa, two slices of bread and a pat of butter, and sometimes an egg or fruit. The midday meal is varied according to the age of the child, and is also changed from time to time as it is placed on the table. A dish of thick vegetable puree, a glass of milk, two slices of bread, a pat of butter and a baked apple form the average midday meal. The main part of the evening meal is shown on a plate containing one kind of meat or fish, potato, macaroni or rice, a green vegetable, two slices of bread, a pat of butter, a glass of water and some stewed fruit.[5] The exhibit is rearranged every day. There are several plates which can be interchanged so as to give variety to the meals. When the exhibit is being explained to a mother, these are changed rapidly so as to impress on her the fact that the diet is not too hard and fast, but at all times the table presents to her eyes a picture of three meals which are well balanced, well cooked, well served and at the same time not beyond the means of the average family.

This exhibit has great educational value. The visual impression made on the mother and child adds tremendously to the significance of the printed list of foods given out on the diet list. In the case of people who do not speak English this is practically the only way in which they can be reached. A list of the units used in the exhibit is as follows:

1 dish of oatmeal with milk
1 dish of cornmeal with milk
1 dish of wheatena with milk
3 plates with two slices bread on each
1 plate with one slice brown bread
1 plate with two or three pieces of Zwieback
3 butter dishes with one pat of butter
2 glasses of milk (8 ounces)
1 cup cocoa
1 orange
1 cookie
1 plate with a poached egg on toast
1 plate thick vegetable soup
1 plate puree of peas
1 plate Irish stew
1 plate with chop, baked potato, spinach
1 plate with fish (boiled halibut), rice, string beans
1 plate with meat ball, macaroni and carrots
1 baked apple
1 plate apple sauce
1 dish prunes

5. The exhibit was made up in large part by Yaeger & Co., 1495 Third Avenue, to which were added foods obtained from other sources. The imitations are so real in appearance that nearly every one is deceived at first glance. They are durable and not expensive. The food exhibit is also of great value in teaching students. The hearty evening meal may meet with some objections. This has been advised for schoolchildren because of the short noon hour and because it saves the mother from cooking two dinners, since the father must have his main meal at night. For younger children the hearty meal is at noon.

It is very simple to calculate the food value of the day's total from the portions comprising the various meals. Nearly all of the foods are arranged in portions approximating 100 calories each and the total calories a day can be rapidly reckoned with a reasonable degree of accuracy.

Besides the three-meal food exhibit we also use a certain number of hundred calory portions to compare foods of low and high energy content. Thus, a half ounce of olive oil, 5 ounces of milk and a quart of soup placed in a row make an impression which is of no small value. In the class of society with which we have to deal, however, it is futile to attempt to spend much time in educating ignorant mothers as to accurate hundred calory portions. It seems to me that the food value is the thing which the physician should constantly carry in his own mind in prescribing diets, but the less the patient is confused by extra and somewhat artificial factors, the better. Among the better classes, with people of intelligence, the study of food values is useful, and even children can be easily taught to count the calories in their meals; but when it takes every persuasive power which the physician has at his command to induce a mother to cook cereal, and to give the child cereal and milk instead of coffee and a roll, it is absurd to distract the mother with the discussion of the amount of a hundred calory portion. If children can be taught to take a bowl of cereal and a portion of vegetable and cooked fruit, the battle is half won.

Class talks are given frequently to groups of mothers for the purpose of saving time, and the effort is made to include in these the mothers who are newest in the class. From time to time talks or lectures are given to the entire class, and the whole matter of the daily régime and the diet from every possible angle gone over again and again in the hope that reiteration will drive home the things we are trying to teach. Wall charts have been very useful, one showing what makes a child gain, and another what makes a child lose. (Figs. 3 and 4.) A great many of the children have memorized these charts and recite them off in chorus like children in school.

Return Visits.—At the first visit the children and mothers are urged to return once a week. On account of the large number of patients under observation this interval has been increased to two or three weeks as soon as the child has begun to do well, but if the gain stops he is again asked to come each week. At the return visit the children are seen in groups, but each child is given individual attention. Twenty or thirty children stand around the physician's desk while he talks to each in turn, reads the notes made by the social worker or volunteer assistants, and the home record made by the child, and makes additional notes on the patient's progress. A rubber stamp is used for

noting the principal facts of the child's hygiene and diet, and this is filled in whenever a child fails to gain a satisfactory amount.[6] This insures more or less parallel series of records on the return visits.

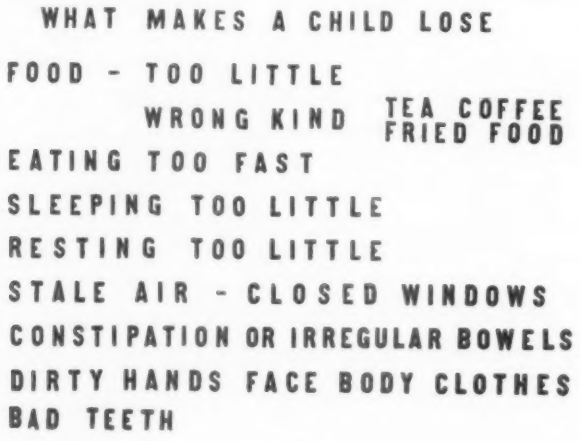


Figure 3

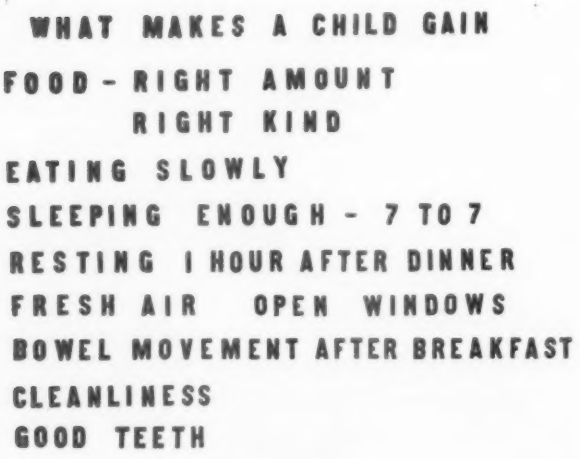


Figure 4

Figs. 3 and 4.—Large wall charts which are used as texts on which to base class talks. Charts of this kind may be easily made by the use of gummed letters.

The questions can be asked and the blanks filled out by a volunteer lay worker after comparatively little training. By this group method every child hears the correction of the mistakes of every other child

---

6. **Breakfast**
Dinner
Supper
Bed at **Up at**
Bowels move at
School hours
Out doors
Reason for loss

and each child gets a maximum number of impressions as to the desirability of regular habits and diet. The children are asked to correct each others' faults also. It is most interesting to see how well some of the children pick out the reasons for the failure of a given child to gain.

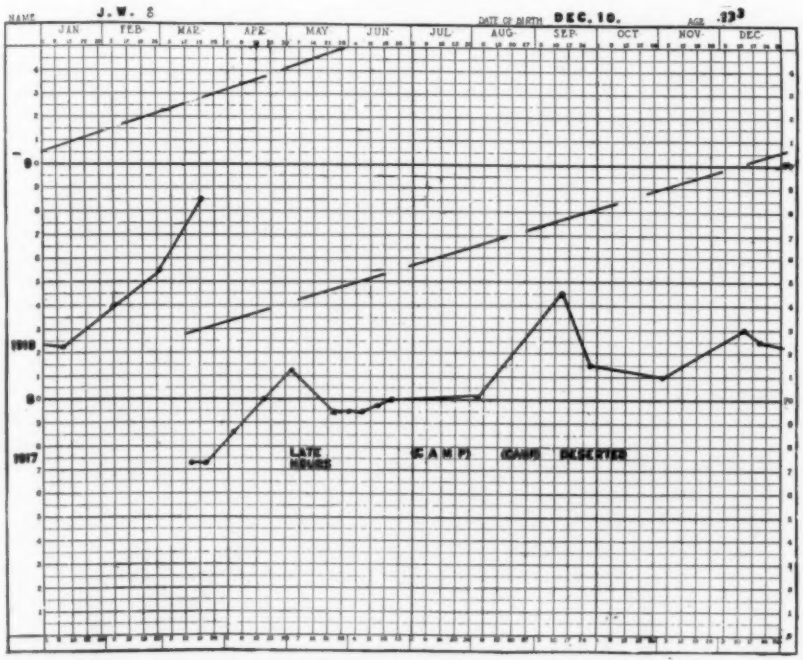


Fig. 5.—J. W., boy, aged 13 years 3 months. This boy was of average height (56½ inches) and nearly 6 pounds under weight. When he first came he had been taking the usual insufficient and improper diet, his bowels were irregular, he rarely went to bed before 10 or 11. Teeth, six cavities; von Pirquet positive. He responded to the suggestions given at the class and gained well at first, but after a time became "weary of well doing" and began to sit up late again, with the loss to be expected. In the first four weeks in July he was at a camp in the country but made no gain. Later he spent two weeks at another camp and gained 4½ pounds. In late September the father deserted the family. This affected the boy greatly, he slept little and "grieved for his father." The family income also dropped, but after a few months the mother began to earn enough to buy more food, and the boy rallied from his grief. He has gained 11 pounds in a year, while the expected gain is 10 pounds. The broken line shows the average weight for his age.

The children who have gained well are praised and held up as examples to be followed by the class. If they have gained regularly for several weeks they are told to come less often. Children who have not gained satisfactorily or who have lost are turned over to the social worker or volunteer for careful questioning. The temperature

is taken at each visit in all cases in which a child has failed to gain under apparently good care. After the careful questioning of the child, a second physical examination is made in children who are doing badly, and much of the time is spent in trying to find a correct cause of failure to gain.

Some children are stimulated greatly by pasting a gold star on the chart when the gain has been large. This seems almost too

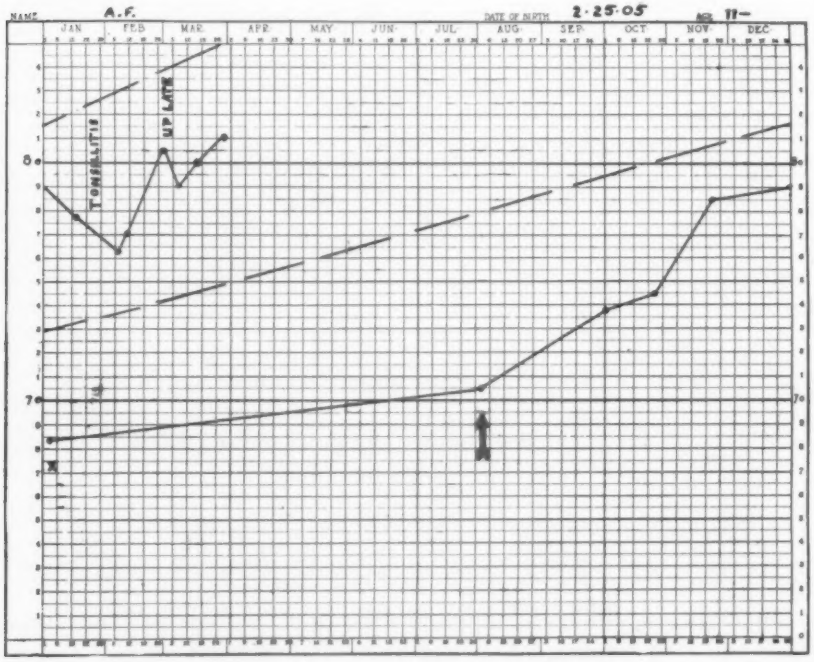


Fig. 6.—A. F., girl, admitted to general clinic for a cold at X. Admitted to nutrition class at arrow. Note difference in rate of gain thereafter. Loss caused by tonsillitis followed by quick recovery. Sat up late two or three nights and lost 1½ pounds, but regained this in the next few weeks when she went to bed early.

On Admission to General Clinic		15 Months Later	
Age	11 years 10 months	Age	13 years 1 month
Weight	67¾ lb. Average 73 lb.	Weight	81 lb. Average 84 lb.
Height	56½ in. Average 54½ in.	Height	57 in. Average 57 in.
Average weight for height	81 lb.	Average weight for height	84 lb.

Broken line is average weight for age.

trivial to be of consequence, but the gold star has certainly encouraged a great many children to keep on trying. Prizes have even more value. A monthly prize is given for the greatest gain for each boy or girl. The children are asked to pick out their own prizes to a certain extent; that is, the children are asked to suggest prizes which they

would think worth trying for. Pencil boxes, boy scout suits, skates, toys and dolls are not very expensive and are effective.

Children have not been sent away from home unless it has been proved by a thorough test that they cannot be made to do well in their homes. If the test at home is a failure, a month or two away in a good institution or camp often starts a gain and establishes a habit of growth which continues after the child's return. Short stays in fresh

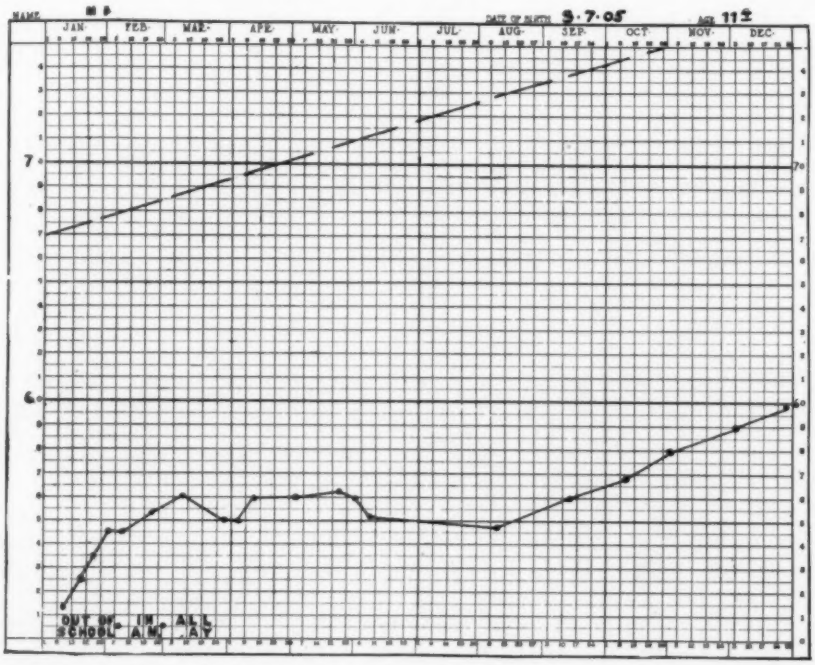


Fig. 7.—M. P., girl, aged 11 years 4 months, shows the effect of school attendance. When this child first came to the class she was taken out of school, made to rest every afternoon, and kept out of doors the rest of the day. She gained a pound a week for three weeks. She was then allowed to go back to school in the morning. The rate of gain at once fell off. After three weeks more she was allowed to return to school all day, and she lost. The weight remained stationary until the middle of the summer vacation. During the fall months after school reopened especial attention was paid to this child and she began to gain, but only at the average rate. Broken line is average weight for age.

air camps are rarely of value, and the children who have been away for a few weeks for trips of this kind have been benefited little as a rule. Indeed, many have lost weight, and have reported that they have received tea, coffee, and other food which has been manifestly improper.

The influence of school is often marked. Certain children will not gain as long as they are subject to the nervous stress and confining hours of the public school. A large number begin to gain as soon as

vacation commences, and this has been true in some cases even when the child has gone to work during the summer. As a routine procedure, if a child does not gain in school, he is taken out. He is allowed to be out of doors in the morning, one or two hours rest are insisted on after the midday meal in a room with wide open windows, and he is allowed to be out the remainder of the afternoon.

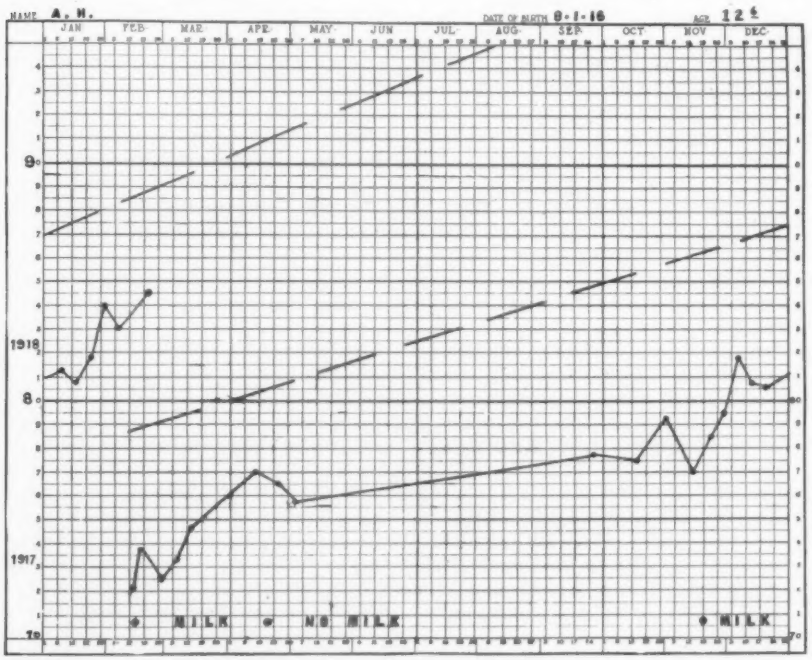


Fig. 8.—A. H., girl. On admission, weight, 72 pounds; average, 78½; height, 57½ inches; average, 56; average weight for height, 85 pounds. This child is over height and under weight, tall, thin, pale. Teeth, three decayed; von Pirquet, 4 plus; otherwise normal; father alcoholic; mother never attends class. Income of family, $46 a month for six persons, or $7.57 per person. If only 50 per cent. of this is spent for food, as economists say is proper, it means that less than 80 cents may be spent per week per person for food. It is easy to see why this child received no milk at home. When she was first admitted she was given a quart of milk a day by a charitable agency and gained 5 pounds in eight weeks. The milk was stopped, she did not attend the class and gained no weight for seven months. Milk was again furnished and she gained 7½ pounds in three months.

In extreme cases, especially when there is marked anorexia, a complete rest cure is given. The child is kept in bed all day in a room with the windows wide open. A laxative is given each night, since constipation often results from the inactivity. The response to the rest cure is rarely delayed more than a week. The appetite invariably comes back, and a gain in weight begins. The child may then be allowed up a

few hours a day and the rest reduced to the afternoon nap. After a gain of several pounds is obtained these children are allowed to return to school in the morning, and later on for the whole day. Too often the return to school marks a cessation of the gain (Fig. 7).

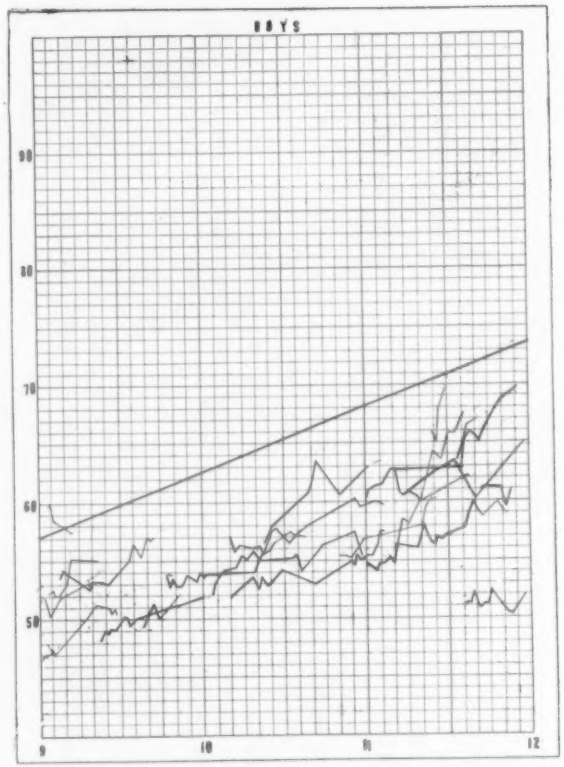
Weight Charts.—Weight charts are used for every child. These are of two types: The *individual weight chart* is printed on a stiff card the same size as the history folder. It is ruled off in pounds and half pounds, covers 25 pounds in a vertical direction, and fifty-two weeks in a horizontal. Each vertical line is dated so that the weight can be charted on the actual day of the month. This makes the charting much more rapid and simple than attempting to calculate the age of the child in years and months, weeks and days; and since we merely desire to show gains and losses it enables us to have a much larger chart and make the gains and losses relatively larger than is possible on a chart based on the child's age. If desired, the average line can be plotted so that the child can see how far below average his weight actually lies. These charts can be used for more than one year, as a rule, the line simply beginning over again at January when December is finished.

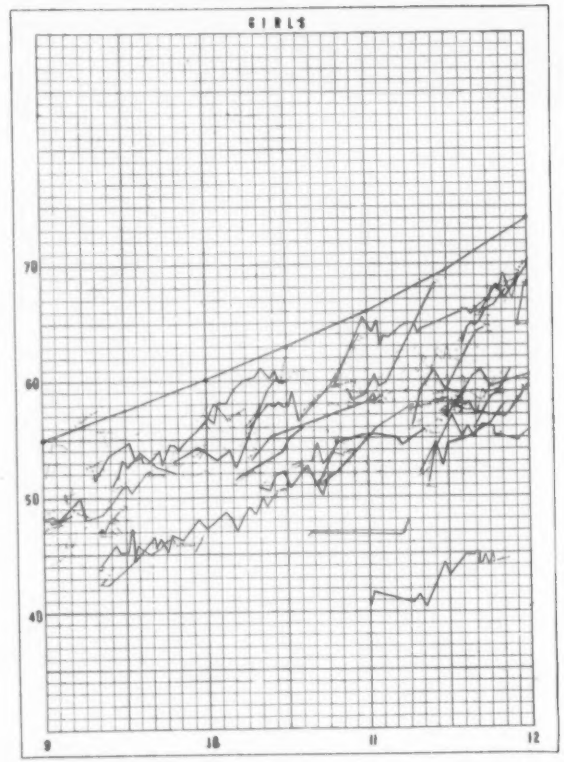
Important facts, such as tonsillectomy, acute illness, etc., may be noted to account for great variations in weight. The children learn to interpret the charts and can readily tell good from bad. There is no question that they are valuable in stimulating the child to try to gain weight. Several examples are reproduced to show the manner in which they are used (Figs. 5, 6, 7 and 8).

The second might be called the *collective charts.* These are large wall charts printed on a heavy coated cloth (size 22 by 30 inches). The weights of the entire class are plotted on these as well as the average normal weight line. Each one covers a period of three years by months, each square representing a pound in the vertical direction and a month in the horizontal. Each child's curve is plotted according to his weight and age. The girls and boys are charted separately. In cases in which the curves lie too near together, half the curves are transferred to another sheet.

Figures 9, 10 and 11 illustrate the use of the collective weight charts. In the first place, they show how much below the average weight for age the children have been. It is apparent that the children fall into two rough groups: those only moderately under weight (about 1 year or 5 to 10 pounds), and those much under weight (more than 1 year or over 10 pounds). These correspond in a general way to Groups III and IV of the Dunfermline scale.

It is evident that the younger children (and this is true for both boys and girls) are less under weight than the older. The reason for this may be that since they are younger they have had less time to fall behind. In the case of the older children the causes of the mal-





Figs. 9 and 10.—Collective weight charts of children in the Nutrition Class. Each irregular line represents the weight curve of a single child. Figures at the bottom indicate years, each square one month in a horizontal direction. Figures at the left indicate pounds, each square one pound vertically. Average weight line for age plotted on each chart.

nutrition have operated for a longer time and there is a greater weight deficit. The gain in weight has been much less at the younger ages, and it may be noted that only a few have gained at more than the average rate. This may be explained by the fact that it is more difficult to appeal to children under 9 years. They are not so much interested in trying to gain, as a rule, while the response is easier to obtain from older children. Perhaps an additional factor is that the tendency to gain weight is greater as puberty is approached, and this natural stimulus to growth exerts its force if the opportunity is given by any improvement of the diet and hygiene of the child.

In general, the weight curves which lie near the average line show a larger gain than those much below the average. This is probably because the children who are most underweight are most difficult to help. The causes of their malnutrition must be more serious and more difficult to remove than the causes which have affected the children only slightly underweight.

By means of the collective weight charts it is simple to compare with the average line the progress of the individual children and of the class as a whole. A general view of the charts gives an impression as to how the children are doing. By measuring the vertical and horizontal extent of any one of the curves, the weight gained and the time under observation are obtained. The average line may be measured for the corresponding length of time and the result compared with the first measurement. For example, a weight curve covers six and one-half months from left to right and 9 pounds from below up. The average line covers 4½ pounds in the same length of time so that the child has gained at twice the average rate. A piece of cardboard ruled on the top to correspond to the months, and on the left to correspond to pounds makes this measurement of the curves rapid and simple.

A *photograph* is taken of every child in the class, and is pasted on the back of the weight chart. This is done very inexpensively by taking three or four children at once and cutting up the finished prints. The photographs have value in helping the physician and nurse to recall to mind any child who has been absent for a long time. They also arouse the interest of the children in the class and later photographs are useful in showing improvement. It is easy to take fairly good pictures with an inexpensive camera, by taking time exposures, and by using one of the newer high powered nitrogen lamps if necessary.

Home Records.—Sheets[7] are used for the purpose of having the child or mother record what happens to the child each day. In many

7. This form was devised by Dr. H. L. Dowd for use in the Huddleston Memorial Class for Cardiac Children.

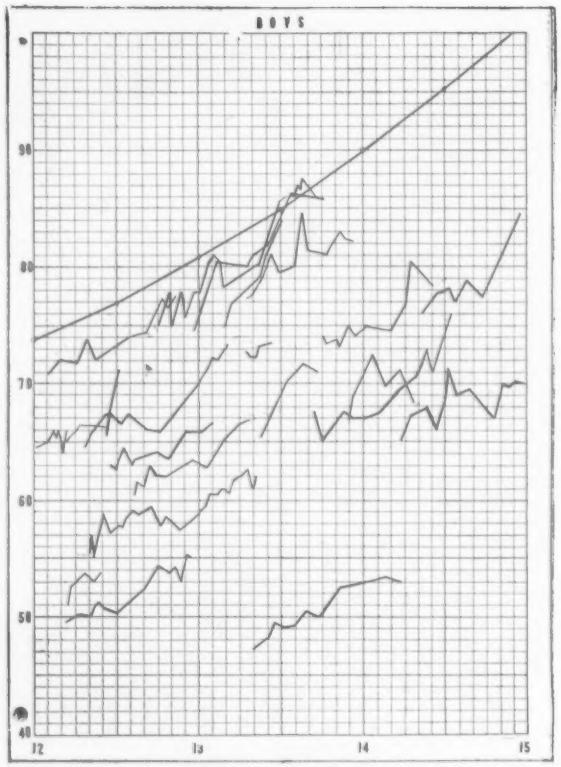


Fig. 11.—Collective weight chart of older boys in the Nutrition Class.

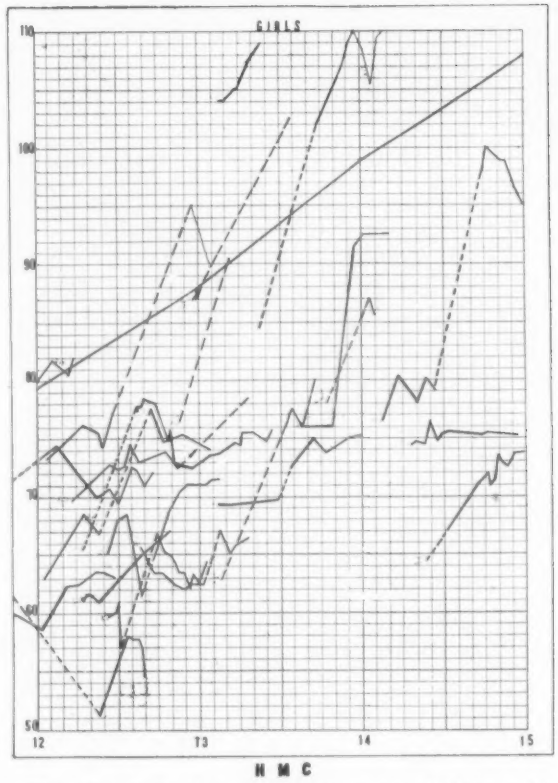


Fig. 12.—Collective weight chart of children with heart disease who have been under control. Continuous portions of each curve represent time spent at home; broken portions the time spent at Pelham Home.

instances this home record has enabled us to pick out the reason for failure to gain when the verbal report had given us no clue (Fig. 13).

Large wall charts of coated cloth are used for summarizing facts of importance. These are ruled horizontally to hold fifty names and vertically into columns in which are entered all the data which are of interest. It is much quicker to get statistics from these sheets than from the individual charts, since all the facts of one kind appear in the same vertical column. Corresponding numbers make it easy to find the names on these sheets.

Milton S. Mar 4 – 11

HOME RECORD CHART

Fill this out each week and bring to the Clinic

	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY	SATURDAY	SUNDAY
What time did you get up?	7.30	7.20	7.20	7	7.30	9	10
BREAKFAST At what time? What did you eat? How much of each thing?	8.40 Oatmeal 1 bowl Bread 1 slice	8.30 Oatmeal 1 bowl Slice bread	8. Cup. Cocoa 1 slice bread	8.30 Glass Milk 2 pieces bread	8 1 Glass Milk 2 pieces bread	9 Cocoa. Cup Bread	10.30 Oatmeal Bread 1 slice
At what time did the BOWELS move?	8.40	8.30	8.45	8.30	8.15	9.18	10.30
SCHOOL HOURS	9-12	9 to 12	9 to 12	9-12	9-12	No school	
DINNER At what time? What did you eat? How much of each thing?	12 Chicken Soup bread applesauce	12 sweet bread soup prunes	12 Soup Chicken Rice	12 Soup Chicken potatoes prunes	12 Baloney Bread	12 Chicken soup Cabbage prunes	1 Soup meat bread
SCHOOL HOURS	1-3	1-3	1-3	1 to 3	1-3	10	No
REST HOURS	None.						
OUT DOORS Hours What did you do?	None	2 hours watched playing ball	2 hours watched playing ball	1 hour watched cattle.	2 hours Went to Y.M.C.A.	To Library 1 hour watched cattle	No
SUPPER At what time? What did you eat? How much of each thing?	6.30 1 egg, cocoa bread 4 prunes	6.20 2 eggs 2 glasses milk 2 pieces bread	7.00 1 egg 1 glass milk 5 pieces bread	6.30 1 egg 1 glass milk 5 pieces bread	6.30 chicken soup bread prunes	6.30 2 eggs 1 cup cocoa 4 prunes bread	6 1 egg 1 cup. cocoa 3 pieces of bread + piece cake
What did you eat BETWEEN MEALS?	An apple	An appl.	An apple	An apple	apple and orange	an apple	an apple
What time did you go to bed?	9	9.11	9	9.15	9.20	9.30	9.7 PM
Did you SLEEP well?	yes	yes	yes	yes	yes	yes	yes
REMARKS							

Fig. 13.—Home record chart as filled out by the child.

Causative Factors.—Although this article deals with methods in the main, a brief summary of the causative factors which we have found may be here included.

The causes which seem to be most prominent may be divided into two main groups:

1. Malnutrition due to real disease or abnormal condition. (*a*) Tuberculosis is the most common real pathologic condition which gives rise to malnutrition without giving marked symptoms or signs. This tuberculosis is not pulmonary, but usually in the lymph nodes in the mediastinum or elsewhere. It may be latent or active at the time the

patient comes under observation, and the malnutrition may be the only sign, aside from the positive skin reaction. The diagnosis is difficult, since the physical signs of diseased bronchial nodes are so slight as to be easily overlooked. D'Espine's sign and the roentgen ray at times are of service in clearing up the diagnosis. An irregular fever is the most suggestive sign of active tuberculosis.

(*b*). Chronic absorption from decayed teeth, diseased tonsils, chronic otitis, ozena or any other local focus of infection is quite sufficient to cause malnutrition.

(*c*). Defective nasal breathing due to enlarged adenoids or obstructed nasal passages is a common condition found among these children and must be corrected before the nutrition can be improved.

(*d*). Prematurity, small size at birth, or difficult feeding in the first year may place on a child a handicap which may not be outgrown.

(*e*). Severe or repeated gastro-intestinal attacks in the first few years, chronic indigestion especially of the intestinal type, and frequent attacks of cyclic vomiting are among the less common causes for undernutrition in older children.

(*f*). Serious illness (as typhoid or severe pertussis) or a combination of several acute infectious diseases within a few months may cause a loss of weight from which it sometimes takes years to recover.

Syphilis, diabetes, chronic nephritis, malaria, intestinal parasites and all other wasting diseases must be ruled out before a case can be considered simple malnutrition. There is also a small number of children in whom there is a change or deficiency in some of the internal secretions which is responsible for the small size. These cases are not easy to recognize when they are not of the typical varieties.

2. Malnutrition due to faulty hygiene and diet. It is important to bear in mind that bad habits of living are due to two main fundamental causes — poverty and ignorance. When the former is the main cause, it is of course more difficult to improve a child's condition. Educational efforts directed at the ignorance of the parents, when well received, offer the greatest hope of success. Bad racial habits of living may be added to the foregoing (as in Italians).

The bad habits of living include every phase of the daily life of the child. They may be briefly summarized as follows:

(*a*). Insufficient food. A very large proportion of the children of the poor receive too little to eat. A breakfast of coffee and a roll, lunch of tea or weak soup and bread, and a supper of meat and potatoes, or of a dish of macaroni, is a diet which furnishes one third to one half the necessary number of calories for proper growth. This is a sample of a day's dietary which appears again and again on our history sheets. In many cases children go to school with no breakfast,

or have no lunch at all, especially when the mother goes out to work. Even in families in which the income is adequate the food taken by the child may be insufficient in amount on account of ignorance of the parent or some whim of appetite of the child.

(*b*). Improper food is also commonly taken. Tea and coffee, fried food of all kinds, pies and pastries, cakes and sweets, raw fruit in excess, too much meat (twice or three times a day) are only a few of the errors in this direction.

(*c*). Bad habits of eating, such as eating too fast, washing down food with copious draughts of water, and eating at very irregular hours all tend to cause indigestion and to prevent the proper utilization of the food taken.

(*d*). Constipation or irregular bowel habit have been almost the rule among the children when they have first come to the class. It has been a rare exception to find a child whose bowels have moved regularly at the normal time, after breakfast and before school. Unless this normal habit can be established, it is practically impossible to make a child gain in weight.

(*e*). Insufficient sleep. Most children in the tenements sit up late and as a consequence get up late. The result is too little sleep, and too little time before school in the morning, so that the child must rush off to school without breakfast or movement of the bowels. The afternoon rest or nap is abandoned as soon as a child is old enough to struggle through the day without it, which may be as young as two years.

(*f*). Insufficient fresh air by day and by night. Long school hours and short days mean that no school child can be out more than an hour after school through the winter months. Windows are rarely opened at night. The crowded flat is lighted by gas, with a stove keeping the temperature of the kitchen well above 80, while the bedrooms are unheated and unaired. This makes a combination which predisposes to respiratory infections and results in general ill health.

(*g*). Insufficient exercise in the fresh air, or too much exercise with insufficient food and rest.

(*h*). Uncleanliness of body and clothing. Dirty mouths and noses have a more direct influence on the general health than dirty skins, perhaps, but there can be little question that bathing predisposes to health.

Results.—An analysis of 110 cases has been made to determine the results of the class experiment. Children have been selected who have been under observation from six to fifteen months, because it is only by taking such cases that the results can be fairly estimated. A great many children gain very rapidly in the first few weeks of their atten-

dance, but do not continue to do well for long. The shorter cases have therefore been excluded. In none of the 110 children has there been found any organic disease of importance. There are in attendance at the class a number of children who have more or less active tuberculosis (not pulmonary, but probably of the bronchial lymph nodes). These children are not included in the summary. They are allowed to attend the class because they need exactly the same attention as the malnutrition cases, and it may be said that their response to the class treatment has corresponded in general to that of the other children, except when they have had fever. They have not been transferred to the children's tuberculosis class because they have not pulmonary disease, and it is extremely undesirable to put on a child the stigma of tuberculosis unless there is some good reason for it. Under the present rules of most institutions, it is not possible to send such children to a preventorium unless there is another case of tuberculosis in the family, so the nutrition class seems to be the best place for them. There are, of course, a large number of children who have latent tuberculosis who are included in the 110 summarized, since many of them have strongly positive von Pirquet reactions.[7]

Of the 110 children, fifty-nine were girls, fifty-one boys. This whole group has gained at about one and one quarter times the expected rate for their ages. Sixty-three children (57 per cent.) have done better than the average and have gained at 1.7 times the expected rate. Of the remainder, twenty-four (22 per cent.) have gained at the average rate, and twenty-three (21 per cent.) at less than the average rate.

There is some question as to whether the children who have gained at the average rate should be included among those who have done well or among those who have done badly. There are two ways of looking at the matter. It may well be said that a child who gains at no more than the average rate is no better off at the end of the year than he was at the beginning, since he is just as much underweight. On the other hand, it is something to get any gain at all among these children, for we know that many of them have a stationary weight for months at a time, as may be seen from the weight curves of some of the children who have done badly. It is to be hoped that a start in gaining, even if only at the average rate, may be followed by a more rapid gain later on.

The best single gain was that of a boy who gained 12.5 pounds in six months, which was at five times the average rate. The worst two boys gained at only six tenths the average rate.

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7. Of 152 children in which the von Pirquet was accurately observed, the reaction was positive in 82 cases, or 54 per cent.; negative in 70 cases, or 46 per cent.

The results in a class of this kind may be compared with that of a controlled group of children. The Huddleston Memorial Cardiac Class has had the privilege of sending children to the Pelham Manor Summer Home for the past year. Children with heart disease have been sent there for rest and care. Of thirty-two girls with organic heart disease who were at Pelham for an average of three and one-half months the gain was at 3¼ times the average rate. Several of them gained 15 to 18 pounds in three to four months. The lives of these girls were under careful supervision, their daily régime was properly regulated, and they had enough to eat. This shows how easy it is to obtain large gains with classes under complete control. Figure 12 shows one of the weight charts of these children and includes the girls from 12 to 15 years. The portions of the curves which are solid represent the weights while the children were at home, the broken lines are while they were at Pelham.

The class is composed of children of many races; about one third are Italians, one third Jews, one fifth Irish. They come in large part from one of the poorest sections of New York City. The average income per month for the family, divided by the number in the family, gives an estimate of the income per person per month. This income per person for the 110 children included in the summary has been $12.40 per month. This is not an accurate measure, because children are not supposed to have as much money spent for their food as adults. It gives a rough measure of income, however, and has the advantage of simplicity. The sixty-three children who have gained at more than the average rate have had an income per person per month of $12, or a little less than the class average, showing that it has not been entirely a question of having more money to spend. The children in Group III have averaged $12, those in Group IV, $13. Here again poverty does not seem to have been a factor.

Of the twenty-three children who have done least well — that is, who have gained at less than the expected rate — the following facts are significant:

The incomes of the families of 17 of the children average only $9.50 per person per month.

The mothers of 15 children never attend the class.

The von Pirquet reaction is 2 to 4 plus in 13.

The races are, Italian 9, Irish 7, Jews 3, miscellaneous 4. This is a higher percentage of Italians and Irish and lower of Jews than the distribution in the entire class. Many of the Italian mothers speak no English, and it is to be expected that the proportion of children who have done badly would be higher in this race.

Relief.—The usual charitable agencies have been appealed to in most cases needing relief. There have been no funds at the disposal

of the class, but the Bellevue Social Service Department has been most kind in giving emergency aid when it has been needed. Small sums have also been given for milk or other food and for clothing by some of the volunteers interested in the work. This experiment has not been one in relief work primarily, but in educating the mothers and the children in matters of every day life.

The results obtained are far from ideal. It must be remembered, however, that we have been dealing with the poorest class of dispensary patients; that the first months of such work must be largely spent in obtaining equipment and devising methods; that the numbers treated are so large that the amount of individual attention given to each child has been reduced to a minimum; and that the past year has been the worst year in the history of the country as far as the rise in price of food and the disproportionate rise in wages. Under these circumstances it is remarkable that even these results have been obtained.

CONCLUSIONS

By the use of the class methods described it has been possible to make 57 per cent. of the children gain at 1.7 times the average rate for their ages, and 22 per cent. at about the average rate, or a total of 79 per cent. who have gained at or better than the average rate. Of the remaining 21 per cent., there is one or more easily ascertained reasons for the failure in every case. These results have been obtained under the most adverse circumstances.

It seems fair to conclude that the class method is of value in the treatment of undernourished children, even when they must be handled in large numbers. The establishment of such classes in all out patient departments, and perhaps in many of the schools, would be of great service to every community, not only by the good done the children treated, but also by the education of the public in matters of hygiene. Parents must be made to realize that a thin child is not a healthy child, and that he needs medical supervision.

The problem of infant mortality has been solved in large part by means of classes for teaching mothers the care and feeding of infants. If the malnutrition problem can be attacked on a large scale by similar means, there is little doubt that comparable results will be obtained.

253 West Seventy-Fifth Street.

STUDIES OF INFANT FEEDING. X.

THE DIGESTION AND ABSORPTION OF FATS. I.

CALCIUM IN ITS RELATION TO THE ABSORPTION OF FATTY ACIDS *

A. W. BOSWORTH, A.M., H. I. BOWDITCH, M.D.
AND
LOUISE A. GIBLIN, B.S.
BOSTON

INTRODUCTION

It is a fact well recognized by pediatrists that the digestion and absorption or nonabsorption of fats is probably the source of a greater part of the troubles encountered with bottle fed infants who receive cow's milk in some modification. Frequent examinations of infants' stools to detect the presence of fats and soaps, and great care taken to prevent the continued presence of an excess of soaps in the stools, are common routines in many hospitals.

Many cases of so-called "infantile atrophy" and most cases of "fat intolerance" apparently show abnormalities with respect to fat metabolism and their general condition can be improved by withholding fats to some extent. While such cases have generally been considered to show abnormalities in their metabolism of fats, a study of them soon convinced us that the trouble is one due to a faulty feeding, for any modification of cow's milk which gives a food containing the desired amounts of fat, sugar and protein does not modify or rearrange the inorganic constituents of the milk.

Cow's milk is nature's food for the offspring of the cow, contains inorganic constituents in sufficient amounts to supply the demands of the rapid growth and development of this animal and is especially rich in calcium and phosphoric acid, substances which the young of the cow use to develop rapidly growing bone tissue, but which the infant uses very sparingly. When fed to infants in the proportions found in cow's milk or modified cow's milk these substances are greatly in excess of the amounts required to supply the demands of the infant, and hence are eliminated either in the urine or feces.

In this connection it is a noteworthy fact that notwithstanding the high calcium content of cow's milk the calcium metabolism of bottle fed infants, as measured by the calcium eliminated in the urine, is

* Submitted for publication March 28, 1918.
* From the Boston Floating Hospital Laboratories, and the Pediatric Department of Harvard Medical School.

seldom greater, and often less, than that found in breast-fed infants, most of the calcium being eliminated in the feces as insoluble calcium phosphate and calcium soaps (Table 1). While this mode of eliminating the excess calcium present in cow's milk is in one way a protection to the infant, in that it prevents the calcium from entering the body fluids and tissues in organic combination, subsequently to set up a toxic condition (unpublished work from this laboratory), it may, on the other hand, bring about marked nutritional disturbances.

TABLE 1.—THE ELIMINATION OF CALCIUM, PHOSPHORIC ACID AND FAT WITH BREAST FED AND BOTTLE FED INFANTS

	Breast Fed	Bottle Fed *
Laboratory number	108	70—1
	Grams Per 24 Hours	Grams Per 24 Hours
Calcium oxid in urine	0.069	0.025
Calcium oxid in feces	0.038	1.672
Phosphoric acid [P_2O_5] in urine	0.012	0.342
Phosphoric acid [P_2O_5] in feces	Trace	0.586
Neutral fat and fatty acids in feces	0.093	0.970
Fatty acids as soaps in feces		4.560

* Seven hundred and ninety-five c.c. of a formula containing 2 per cent. fat, 6 per cent. sugar and 1.6 per cent. protein.

The question of calcium metabolism is being given especial attention in the laboratories of this hospital. The examination of many stools from bottle-fed infants in this connection has led us to believe that although neutral fat, free fatty acids and soaps may all be found in these stools, the appearance of neutral fat and fatty acids, except in the case of diarrhea, are wholly secondary, and in most cases do not in any way indicate an impaired digestion or absorption, but rather a faulty feeding which allows an excessive amount of calcium, available for soap formation, to enter the intestines where the conditions are very favorable for the formation of insoluble calcium soaps. These soaps as they are precipitated may carry down with them by occlusion both neutral fat and free fatty acids. If the possibility of the excessive formation of insoluble calcium soaps is removed by the feeding of a decalcified milk, or one with a calcium content about equal to that found in breast milk, it has been found that infants unable to handle any fat in a modified milk can take 3 per cent. of fat in a decalcified or reconstructed milk. This point is clearly demonstrated by the figures given in Table 2.

TABLE 2.—Showing Decreased Amounts of Fat and Soap in Infants' Stools When Excess Calcium is Removed from Food. Lab. No. 101

Date	Dry Weight, Gm.	Total Fat, Gm.	Neutral Fat and Fatty Acid, Gm.	Fatty Acid as Soaps, Gm.	Calcium Oxid, Gm.	Phosphoric Acid, Gm.	Food	Fat Ingested, Gm.
1916								
March 12. ...	6.94	4.23	0.61	3.62	0.934	0.121	Modified milk with 2 per cent. fat.	24.0
March 13.....	7.44	5.19	1.84	3.35	0.765	0.124		22.2
March 14.....	4.82	2.59	1.01	1.58	0.318	0.054	Decalcified milk with 3 per cent. fat	28.5
March 15.....	3.09	0.66	0.26	0.40	0.012	0.007		36.0
March 16.....	2.47	0.48	0.30	0.18	0.010	0.017		36.0
March 17.....	2.65	0.53	0.19	0.34	0.010	0.035		31.3

I

NATURE OF THE FATTY ACIDS IN THE SOAPS PRESENT IN THE STOOLS FROM BOTTLE-FED INFANTS RECEIVING MODIFIED MILK

In an attempt to determine the nature of the soaps present in infants' stools we have collected a number of the firm, characteristic soap stools usually eliminated by infants receiving modified cow's milk, such infants as are often constipated and frequently show marked distention of the bowels due to the accumulation of gas.

Technic.—One-gram portions of the dry stools were extracted with acidulated ether-alcohol mixture, the extract evaporated to dryness, dissolved in chloroform and neutralized with sodium ethylate. The chloroform was distilled off and the soaps dissolved in water and filtered to remove any neutral fat present. The fatty acids were then precipitated by the addition of hydrochloric acid, dissolved in ether, the ether distilled off and then dried in a desiccator under diminished pressure. The melting points of the fatty acids separated in this manner, together with the total fat elimination per twenty-four hours, are given in Table 3.

TABLE 3.—AMOUNTS OF FAT AND MELTING POINTS OF THE FATTY ACIDS PRESENT AS SOAPS IN THE STOOLS FROM INFANTS RECEIVING MODIFIED COW'S MILK

Laboratory Numbers	Percentages of Fat, Sugar and Protein in Food	Grams Fat Injected per 24 Hrs.	Grams of Fat in Stools Per 24 Hours*	Melting Points of Fatty Acids Separated from Stools
	F. S. P			
70—1	2-6-1.6	15.9	5.53	54 C.
72—1	2-6-1.6	15.9	2.02	53 C.
73—1	2-6-1.75	20.3	5.03	54 C.
74—1	2-6-2	24.3	6.47	55 C.
77—1	2-6-1.6	24.3	5.01	54 C.
79—1	2-6-1.6	28.2	1.47	54 C.
80—1	2-7-2	24.3	2.26	52 C.
81—1	2.4-6-1.9	31.3	3.99	52 C.
101—2	2-8-1.25	22.2	5.19	51 C.
104—1	2-8-1.25	24.0	3.48	52 C.
109—2	2-8-1.25	24.0	4.16	53 C.
115—1	3.2?-1	39.7	5.04	52 C.
116—1	2.5-4.5-2	34.1	4.68	53 C.
117—1	2-6-1.6	20.3	5.37	52 C.
118—2	2-7-1.5	18.2	4.33	52 C.
119—1	3-5-2	34.1	8.40	51 C.
120—2	2.5-5-1.6	26.1	8.19	50 C.
121—2	2.5-5-1.6	26.1	7.21	50 C.
122—2	2.5-5-1.6	22.7	2.64	54 C.
125—2	2-7-1.5	14.2	3.13	53 C.
126—2	2-6-2	25.2	4.67	52 C.
128—2	2.5-6-2.1	30.9	4.19	53 C.
129—1	3.6-3.2	50.1	7.46	53 C.

* Neutral fat, free fatty acids and fatty acids as soaps.

The fatty acids as obtained for the determination of the melting points given in Table 3 were all united, dissolved in ether-alcohol mixture, filtered through animal charcoal and evaporated to dryness, giving 13.5 gm. The product was evidently a mixture of fatty acids for, at 49 C. it was solid; at 50 C. it was partly melted; at 52 C. it completely melted.

When dissolved in chloroform 0.3 gm. required 10.9 c.c. of tenth-normal sodium ethylate to make neutral to phenolphthalein. The average molecular weight would thus be

$$\frac{0.3}{10.9 \times 10^{-4}} = 275.2$$

The melting points given in Table 3 and the average molecular weight as found in the equation given seem to indicate that the soaps in the stools are soaps of the higher fatty acids found in butterfat, and in order to learn something of the nature of these fatty acids they were dissolved in water by adding sodium hydroxid and then precipitated as lead soaps by the addition of lead acetate, the lead soaps being then filtered, washed with water and dried. The fatty acids were then separated into four fractions in the following manner:

Fraction 1 was obtained by extracting the dried lead soaps with ether to remove the lead oleate. The ethereal solution of lead oleate was then placed in a separatory funnel with some distilled water, a few drops of nitric acid added and the lead nitrate washed out by the addition of several successive portions of water. It was found impossible to remove all the lead in this manner, so the ether was evaporated off, water added and the oleic acid converted to the sodium soap by the addition of a small amount of sodium carbonate, the soap solution thus obtained being centrifugalized and the oleic acid recovered from the clear solution by precipitating with hydrochloric acid, dissolving in ether and drying. We obtained 2.9 gm.

The lead soaps remaining after the extraction of the lead oleate were suspended in water, decomposed by the addition of a few drops of nitric acid and the free fatty acids removed by extracting with ether in a separatory funnel. The ether was distilled off, the acids dissolved in alcohol, filtered through animal charcoal and evaporated to dryness, leaving a mixture of fatty acids having a melting point of 54 C.

This product was found to contain some lead so it was dissolved in water by the addition of sodium carbonate, centrifugalized, and the fatty acids precipitated by adding nitric acid. The fatty acids were washed with several portions of water acidulated with nitric acid, then with pure water and finally dissolved in alcohol and separated into Fractions 2, 3 and 4 by crystallization.

Fraction 2 when examined under the microscope showed pure needle-like clusters of crystallized palmitic acid, and after being washed with cold alcohol and dried gave 4.5 gm. having a melting point of 62 C.

Fraction 3, when examined under the microscope, showed a preponderance of palmitic acid crystals and a few irregularly formed globules. On being dried, this fraction gave 2.2 gm. having a melting point of 56 C.

Fraction 4 was light brown in color, showed a preponderance of palmitic acid crystals and on being dried gave 2.7 gm. having a melting point of 34 C.

About 0.3 gm. of each of the fractions was dissolved in chloroform and titrated with tenth-normal sodium ethylate and the average molecular weights calculated in the manner just given. The results obtained, together with the other data relating to the fatty acid fractions separated from the infant's stools, will be found in Table 4.

We recovered 12.3 gm. of fatty acids in the four fractions. Fraction 1, containing 2.9 gm. of oleic acid, is 23.6 per cent. of the fatty acids recovered. Fractions 2, 3 and 4, containing 9.4 gm. of fatty acids, which are almost pure palmitic acid, represent 76.4 per cent. of the fatty acids recovered.

The data given in Table 4 demonstrate beyond question that a palmitate is the soap present in largest amount in the stools from

TABLE 4.—Showing Amounts, Melting Points and Average Molecular Weights of Fatty Acid Fractions Separated from Infants' Stools

	Grams	Melting Point, C.	Grams Taken	Sodium Ethylate C.c. N/10	Average Molecular Weight
Total mixed fatty acids	13.5	50-52	0.3000	10.9	275.2
Fraction 1, oleic acid	2.9	13-15	0.3758	13.2	284.7
Fraction 2, palmitic acid	4.5	62	0.3219	12.4	259.6
Fraction 3	2.2	56	0.3625	14.0	258.9
Fraction 4	2.7	34	0.3675	13.0	282.7

Fractions 3 and 4 on being crystallized from alcohol showed a preponderance of palmitic acid crystals.

bottle-fed infants, but in order to demonstrate this more directly we have examined a number of stools from bottle-fed infants according to the following technic.

About 0.5 gm. of moist stool is placed in a small test tube, 3 drops of acetic acid and 5 c.c. of alcohol are added and the whole heated to just boiling. This gives an alcoholic solution of fatty acids which is now centrifugalized to deposit the insoluble matter and the clear liquid decanted on watch glasses and allowed to evaporate spontaneously until a marked crystallization has taken place. One drop of this mixture of liquid and crystals is now placed on a microscope slide and examined under the microscope.

In every case we found an abundance of palmitic acid crystals and could not find crystals of any other nature. It should be added that oleic acid was undoubtedly present, but as this acid is a liquid at ordinary temperatures, it would remain in solution in the last traces of the mother liquid surrounding the palmitic acid crystals.

The next point to be determined was the nature of the base which had combined with the fatty acids to form the soaps. Stools from the type of infant under consideration always show an excess of calcium over that required to form insoluble phosphates with the amounts of inorganic phosphorus present, and it seemed evident from the first that the soaps present were insoluble calcium soaps, and this suspicion was confirmed by the following procedure:

Portions of the stools were placed in Erlenmeyer flasks with 100 c.c. of water and brought to the boiling point, any sodium, potassium or ammonium soaps being thus dissolved in the water. The insoluble material was then filtered off and the fatty acids precipitated from the filtrate by the addition of a drop of hydrochloric acid. In no case was the amount of soap dissolved sufficient to produce more than a slight turbidity when the fatty acids were precipitated by the hydrochloric acid added.

It is therefore seen that the soaps present in these stools were almost wholly insoluble soaps and as calcium is the only insoluble base present in appreciable amount, it must be concluded that the insoluble soaps are calcium soaps.

II

THE SOLUBILITY OF CALCIUM SOAPS IN BILE

It will be seen from the preceding data that the proper utilization of fats by the type of infants under discussion is not a question of digestion, as has quite commonly been supposed, but rather a question of the proper absorption and assimilation of the soaps formed by the fatty acids which are produced by the digestion of fats. These soaps must be absorbed before they can be assimilated, and in order to be absorbed and pass through the intestinal wall into the body fluids they must be soluble in the intestinal juices, or, more definitely speaking, soaps must be soluble in bile in order to be absorbed and assimilated.

Cow's milk contains a large amount of calcium which is carried into the intestines with the other ingredients of the milk and is available for the formation of calcium soaps as soon as the fats are hydrolized by the fat-splitting ferments present in the intestinal juices. It is evident, therefore, that the absorption and assimilation of the digested fats will depend to a very great extent on the solubility in bile of the calcium soaps formed by the fatty acids produced as a result of the digestion of fats. In order to learn something of the solubilities of the calcium soaps of the fatty acids present in the fat of cow's milk, we have performed the following experiments.

A. Pure better fat was saponified by boiling under a reflux condenser with sodium ethylate. The sodium soaps thus obtained were purified and obtained in the dry condition. This mixture of soaps was very soluble in fresh ox bile, but on adding a drop of a 10 per cent. solution of calcium chlorid a heavy cloud was at once formed which settled out as a precipitate on standing. This precipitate was found to be calcium soaps.

B. Some of the mixed soaps as obtained under *A* were separated by the usual method of distillation into two fractions, the volatile fatty acids and the nonvolatile fatty acids. These two fractions were then converted into sodium soaps, the soaps being obtained in the dry condition. Both fractions were readily soluble in fresh ox bile, and on the addition of a drop of calcium chlorid the bile containing the soaps of the nonvolatile fatty acids gave a heavy precipitate, while the bile containing the soaps of the volatile fatty acids remained perfectly clear.

This difference in the solubilities of the calcium soaps formed by volatile and nonvolatile fatty acids has special significance when it is remembered that soaps of the volatile fatty acids are not found in infants' stools in more than traces except in the case of diarrheas.

In Table 5 will be found a statement of the kind and quantity of fatty acids produced by the saponification of 100 gm. of butter fat. It will be noticed that the oleic and palmitic acids together constitute over 71 per cent. of the total fatty acids thus produced, and offers some explanation for the finding previously noted that the soaps in infants' stools are soaps of oleic and palmitic acids.

TABLE 5.—MOLECULAR WEIGHTS, MELTING POINTS AND AMOUNTS OF FATTY ACIDS OBTAINED BY THE SAPONIFICATION OF 100 GM. OF BUTTERFAT[1]

Name	Formula	Molecular Weights	Amounts, Gm.	Melting Points, C.
Dioxystearic acid	$C_{18}H_{36}O_4$	316	1.00	136.0
Oleic acid	$C_{18}H_{34}O_2$	282	32.50	14.0
Stearic acid	$C_{18}H_{36}O_2$	284	1.83	69.2
Palmitic acid	$C_{16}H_{32}O_2$	256	38.61	62.0
Myristic acid	$C_{14}H_{28}O_2$	228	9.89	54.0
Lauric acid	$C_{12}H_{24}O_2$	200	2.57	43.6
Capric acid	$C_{10}H_{20}O_2$	172	0.32	31.4
Caprylic acid	$C_8H_{16}O_2$	144	0.49	16.0
Caproic acid	$C_6H_{12}O_2$	116	2.09	—2.0
Butyric acid	$C_4T_8O_2$	88	5.45	—2.0

We have tried to learn something about the solubilities in bile of the calcium soaps of the nonvolatile fatty acids present in butterfat. This work is not completed as yet and the results so far obtained are rather inconclusive, but we believe calcium oleate shows a higher degree of solubility in bile at 37 C. than do the calcium soaps of stearic, palmitic or myristic acids. If this proves to be true the preponderance of the calcium soap of palmitic acid over the other soaps present in infants' stools will be readily explained.

III

THE CALCIUM CONTENT OF COW'S MILK IN ITS RELATION TO THE DIGESTION AND ABSCRPTION OF FATS IN BOTTLE-FED INFANTS

So far as we know, no one before this has pointed out the important relation which exists in infant feeding between the calcium content of food and the elimination of calcium soaps in the stools. In this connection it should be understood that it is not the mere presence of calcium salts in the food which predetermines the presence of calcium soaps in the stools, for there are other factors entering into the question, such as: the forms in which the calcium is present in the food; bacterial activity within the intestines; and the amount of hydrochloric acid secreted into the stomach which may change certain forms of calcium compounds (that is, dicalcium phosphate) from an inactive to an active condition. In Table 6 will be found a statement of the different forms of calcium compounds found in cow's milk, and in Table 7 will be found data showing the influence of the different kinds of calcium salts (that is, insoluble, colloidal and soluble calcium compounds) on the elimination of calcium soaps in the stools from infants. A study of this table will show that the elimination of calcium soaps in the stools increases directly in proportion to the degree of solubility of the calcium present in the food.

1. Brown: Jour. Am. Chem. Soc., 1899, **21**, 807.

TABLE 6.—CONDITION OF CALCIUM IN COW'S MILK AND HUMAN MILK

	Grams Per 100 C.c.	
	Cow's Milk	Human Milk
Calcium as insoluble phosphate ($CaHPO_4$)	0.051	None
Calcium combined with proteins	0.058	0.014
Calcium as soluble salts in serum (whey)	0.045	0.021

TABLE 7.—SHOWING INFLUENCE OF KIND OF CALCIUM SALTS PRESENT IN FOOD ON THE AMOUNT OF CALCIUM SOAPS ELIMINATED IN THE STOOLS

Lab No.	101—6	122—6	67	78—8	77—1
Age, months	6	4	4	3½	6
Kind of food	Synthetic	Synthetic	Synthetic	Synthetic	Milk
Formula	3-6-1.5	3-6-1.6	2-6-2	2-6-2	2-6-2
Calcium present as	None	$CaHPO_4$	Calcium caseinate	Calcium caseinate and acetate	Milk salts
Grams CaO, per 24 hours	0.00	0.45	0.51	1.55	1.13
Grams P_2O_5					
Per 24 hours	0.29	0.68*	0.38	0.38	1.71
In feces per 24 hrs.					
Grams fat	0.53	1.36	2.14	7.90	5.01
Grams CaO	0.10	0.33	0.48	1.73	0.94
Grams P_2O_5	0.04	0.44	0.31	0.39	0.36
In urine per 24 hrs.					
Grams CaO	Trace	0.02	0.00	0.20	0.06
Grams P_2O_5	0.30	0 ?8	0.00	0.00	0.82

* P_2O_5 in casein 0.23
P_2O_5 in $CaHPO_4$ 0.45
Total P_2O_5 ..... 0.68

It will be noticed from the tables that the dicalcium phosphate is practically inactive, as has been shown by us in a previous paper,[2] all the phosphorus fed as phosphate being recovered in the feces and the phosphorus contained within the casein being absorbed and appearing in the urine. In the case of the foods which contained calcium caseinate, and calcium caseinate plus calcium acetate, it will be seen that the urine became phosphorus free, all the phosphorus in the food being precipitated in the intestines as calcium phosphate and appearing in the feces. This question of phosphorus metabolism in relation to the calcium content of the food is one of very great importance and is being studied in this laboratory.

FAT DIGESTION AND ABSORPTION WHEN RECONSTRUCTED MILK IS FED TO INFANTS

Our investigations on infant feeding have led us to believe that many of the troubles encountered with bottle-fed infants receiving cow's milk must be attributed to the ill effects produced by the calcium in cow's milk.

2. Bowditch and Bosworth: Boston Med. and Surg. Jour., 1917, **177,** 864.

Breast milk is nature's food for the infant, and we may consider the constituents to be so balanced as to meet all the demands of growth, with a minimum of waste. Cow's milk, on the other hand, is nature's food for the offspring of the cow, and is not balanced in any respects as a food for infants, and its use as such must usually be preceded by some form of modifying which will make the quantitative relations between the fat, sugar, protein and water approximately that found in breast milk. In most, if not all, of these modified cow's milks the mineral elements present receive very little consideration, being passed over with the statement that modified cow's milk will always contain a larger percentage of ash than breast milk, and hence will furnish all the mineral elements necessary. The time has come, however, when this phase of the feeding problem can no longer be treated in this manner, and more care must be taken to see that the mineral elements are properly balanced. This adjustment must take into consideration not only the mineral elements themselves, but also their relations to the organic constituents of the food.

Metabolism studies made in this connection must be based on the fundamental assumption that the metabolism of the healthy, normal breast-fed infant shall be used as the standard for comparison, and it must be admitted that no infant fed on cow's milk or any of its modifications can present a picture of a normal metabolism. The fact that a great number of children are successfully fed on cow's milk is no justification for assuming that they present a normal metabolism, for although they may be developing and growing in a normal manner, they are doing so on an abnormal food, not the one provided for them by nature, which necessarily predetermines that an abnormal metabolism must be going on in order that they may handle this abnormal food.

The presence of large quantities of calcium soaps in the stools from bottle-fed infants receiving cow's milk is one of the striking abnormalities noticed when a comparison is made between the analyses of such stools and those from breast-fed infants. As these soaps are insoluble, they can not act as suppository in a manner similar to the sodium and potassium soaps, and as a matter of fact they often cause severe constipation, which, in our estimation, is the starting point for other complications. In studying this type of cases it soon became apparent that the removal of most of the calcium from the cow's milk presented the only possibility for the working out of a successful method of feeding them. It was at first thought that the use of sodium or potassium caseinate with whey and heavy cream would prove of some value, but the soluble calcium salts present in the whey were sufficient to cause the formation of large amounts of calcium soaps.

We have finally perfected a method for reconstructing cow's milk which permits us to remove nearly all the calcium from the original milk. This reconstructed milk posssesses the advantage of a great range in its composition, as will be seen by the figures in Table 8, in which we give the composition of cow's milk, human milk and the possibilities for our reconstructed milk.

TABLE 8.—SHOWING COMPOSITION OF COW'S MILK, BREAST MILK AND RECONSTRUCTED MILK (B. F. H. FORMULA)

	Cow	Breast	Reconstructed
Fat	3.90	3.30	Any per cent. desired.
Protein	3.20	1.50	Any per cent. desired.
Sugar	4.90	6.50	Any per cent. above 2.6
Salts	0.90	0.31	(0.33)
Ash	0.70	0.20	(0.21)
Citric acid	0.24	0.11	0.17
Chlorin	0.08	0.04	0.05
Phosphorus (inorganic)	0.09	0.014	0.001 or more if desired
Potassium	0.12	0.07	0.007
Sodium	0.05	0.02	0.033
Calcium	0.14	0.03	0.009 or more if desired
Magnesium	0.012	0.003	0.008

The details for the preparation of our reconstructed milk will not be given here, for we intend to present this subject in another paper. We can say, however, that its use in all the cases so far tried has produced favorable results, and in certain cases, such as those classed as "fat intolerance" and "infantile atrophy," improvement has resulted from its use, the following case being typical.

This child always eliminated free fatty acids, neutral fats and soaps in his stools whenever a modified milk formula containing 1 per cent. or more of a fat was fed; he was always constipated and the continued ingestion of a formula containing 1 per cent. or more of fat invariably resulted in a so-called "blow up" which was always ameliorated by the withholding of fats. When our reconstructed milk was fed to this child he could digest and absorb 3 per cent. of butterfat, eliminating a stool practically free of fat, fatty acids or soaps, and his general condition improved while he received this food.

OBSERVATIONS ON THE NUTRITION AND GROWTH OF NEW-BORN INFANTS

AN ANALYSIS OF THREE HUNDRED CLINICAL CHARTS

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The medical profession is very reluctant to adopt new standards, but having been once convinced as to their correctness, they are just as loath to discard them. The result is that certain standards such as weights and measures, for example, are copied by one writer after another for years without any one, or at least very few, taking the trouble to verify their correctness. Standards which are correct in one country are often quite incorrect in another country, under different conditions.

The following observations were made from the charts in the ward for new-born of the University Hospital where, owing to the efforts of Dr. Sedgwick, chief of the Pediatric Department, and the cooperation of Dr. Litzenberg, chief of the Obstetric Clinic, all new-born infants come under the pediatric service directly after birth.

The points to be ascertained from an analysis of the charts were as follows:

The average birth weight of infants, male and female.

Average daily amounts of milk received from the mother.

Average caloric intake of babies who were gaining in weight, computed as to number of calories per kilogram of body weight.

Average initial loss in weight.

Apparent cause of the initial loss in weight.

Initial loss in weight in babies who had water in addition to the nursings, compared with that in those who had no water. (In a large series of cases every other one had water.)

Whether the initial loss in large infants was relatively greater than in smaller ones.

Average time during which the initial loss continued.

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*Submitted for publication April 22, 1918.
* Read before the third annual meeting of the Middle States Pediatric Society, Dec. 10, 1917.

Average time when the babies began to regain lost weight.

What factors seemed to determine the gain in weight.

Had the number of stools anything to do with the failure to gain?

What is the average daily number of stools in normal infants during the first ten days?

Does the number of stools depend on the quantity of food received?

What is the average gain in weight during the first ten days?

Does the average infant regain its birth weight during the first ten days?

The average birth weight as given by Camerer and which has been generally accepted and copied widely, is, for boys, 3,400 gm., and for girls, 3,200 gm.

In 300 new-born infants born in the University Hospital the average weights were, boys 3,391 gm., females 3,276 gm.

The average daily intake of breast milk was as follows:

	Days								
	2d	3d	4th	5th	6th	7th	8th	9th	10th
Our amounts, Gm.....	39	100	170	234	275	304	336	352	365
Camerer's amounts, Gm.	91	247	337	350	390	470	...	...	500

As will be noticed, our averages are much smaller. These amounts were determined by five nursings in twenty-four hours at four-hour intervals.

The caloric need of infants as computed by Heubner and Rubner is 100 to 110 calories per kilogram of body weight. This rule has been generally accepted, it being recognized and pointed out by Czerny, Keller and others that there are exceptions in which infants will gain for considerable periods on a less number of calories. Other observers including Cramer[1] and Gaus[2] in Europe, and Morse and Talbot[3] in this country, believe that the rule of 100 calories per kilogram does not apply to babies during the first days, as they gain on less amounts. Salge points out that in cases in which infants gain apparently on a less number of calories than 100 per kilogram the milk is extremely rich in fat and the caloric deficiency is only apparent.

All of our patients who made good gains and left the hospital weighing more than the birth weight, made their gain on much less than 100 calories per kilogram of body weight.

For example, Baby 11578, weight 3,760 gm., gained 360 gm. in seven days. Calories per kilogram per day — 55, 52, 56, 67, 73, 80, 67; average, 64. Average gain per day, 51 gm.

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1. Cramer: München. med. Wchnschr., 1903, **2,** 1153.
2. Gauss: Jahrb. f. Kinderh., 1902, N. S., **55,** 129.
3. Morse and Talbot: Diseases of New-Born and Infant Feeding. McMillan, 1915.

Baby 11572, weight 3,325 gm., gained 260 gm. in seven days, or an average of 37 gm. per day on an average daily quotient of 74 calories.

Baby 12505, birth weight 3,780 gm., had no apparent initial loss in weight. Received 60 gm. of milk on the second day and began to gain on the third day. This baby was complemented in order to bring up the quantity of milk to approximate 100 calories per kilogram. It was found, however, in this case, as well as in several others in which this was attempted, that the babies promptly developed diarrhea, with watery, frequent stools and the amount of milk had to be much reduced. This infant only gained 16 gm. per day on an average caloric intake of 91 per kilogram.

Baby 11565, weight 2,680 gm., began to gain on the third day after a loss of 150 gm.; got 100 gm. on the third day and began to gain on that day. It gained 180 gm. in the succeeding six days; average daily caloric intake, 53 calories per kilogram. Average daily gain, 26 gm.

Another case, Baby 10570, gained 290 gm. in five days on an average caloric intake of 43 calories per kilogram of body weight. Average daily gain, 58 gm.

This infant lost 290 gm. in the first two days, and regained the birth weight on the seventh day. None of these infants had any water. These are only a few of many similar cases.

It is apparent, therefore, that infants, at least during the first ten days, in order to gain reasonably in weight do not require anywhere near 100 calories per kilogram of body weight, that the energy quotient varies in the individual cases from 43 to 75, and that when new-born infants during the first ten days receive 100 calories per kilogram they are usually overfed. I say usually, because there are patients who will tolerate enormous quantities of food, gain steadily and rapidly for considerable periods of time without any evidence of digestive or systemic disturbance.

Regarding the caloric needs of premature infants, it is generally agreed that it is higher than for normal, full-term infants, generally conceded to be from 110 to 120 calories per kilogram.

Baby M., premature, 7 months; birth weight, 1,920 gm.; was given 85 gm. milk on the second day and increasing amounts up to 260 gm. on the sixth day, but continued to lose weight daily and lost 50 gm. on that day, on an average caloric intake of 88 calories per kilogram. The following day the amount was pushed up to 300 gm., equivalent to 100 calories per kilogram, and the baby gained 10 gm. on that day. It was kept on 300 gm. for the next twenty days and gained an average of 10 gm. per day, being discharged on the twenty-eighth day, with a weight of 2,140 gm.

Initial Loss in Weight.—According to Camerer, Schlossman and many others (Camerer's figures are generally copied) the initial loss in new-born infants occurs during the first two or three days and amounts to an average of 200 gm. "After the third day there is a

steady gain of about 30 gm. per day, and by the eighth or tenth day the baby has regained its birth weight" (Camerer).

In our series of cases the average initial loss was 240 gm. and the average time the loss continued was three days.

There have been many theories advanced as to the cause of the initial loss. These theories are so familiar that they need not be enumerated. The chief cause has generally been assumed to be the lack of food and fluid during the first days.

Shick[4] by means of complementary feeding with mother's milk was able in nine cases to prevent the initial loss in weight. The complementary feeding was begun from three to six hours after birth and repeated every two or three hours. An amount equal to from 8 to 15 per cent. of the body weight was given irrespective of the amount received from the nursings. None of the infants suffered any inconvenience, and two actually gained in weight.

In looking over our series of charts it was noticed that the initial loss varied greatly in the individual cases and in some the loss was out of all proportion to the lack of food and fluid. For example, No. 12452, weight 3,740 gm.; got 37 gm. milk on the second day and had lost 255 gm. by the third day; while No. 12505, weight 3,930 gm., received 60 gm. milk on the second day, had no apparent loss in weight and began to gain on the third day.

The infants who are apparently normal, receive an average amount of milk, and show an unusual drop in weight at the second weighing, are frequently those who have a large amount of meconium and perhaps urine and do not pass it until after they are weighed. There is also a marked difference in the amount of vernix caseosa in different cases; so that the removal of this, coupled with the discharge of meconium and urine after weighing, would account for a considerable drop at the second weighing.

Baby 12505, who showed practically no initial loss of weight on the second day, passed a large amount of meconium at birth and had little vernix caseosa.

The continued loss in weight after the second or third day in normal infants seemed to depend on whether there was a lack of an average secretion of milk.

Concerning the effects of water in diminishing the initial loss in weight, every other baby in the series was given water up to 2 ounces after each nursing. This did not seem to affect the initial loss when an average amount of milk was secreted, the loss being as great in those who received water as in those who received none. In cases in which there was practically no milk secreted, the patients who received

4. Shick: Ztschr. f. Kinderh., December, 1915.

water lost less than those who received no water. After the third day, if the milk was insufficient, water seemed to have no effect in restoring the initial loss or in preventing further loss.

The gain in weight seemed to depend on an average amount of food, varying from 43 to 74 calories per kilogram of body weight.

The initial loss in large infants, contrary to what has been generally accepted, was not relatively greater than in small ones. This agrees with Bergman's[5] findings.

Only about one fourth of the infants regained their birth weight before leaving the hospital on the tenth day. This agrees with Bergman's findings in 1,000 cases; only about 21 per cent. had regained the birth weight by the fourteenth day, and more than half did not regain it up to the twenty-first day.

The average daily gain in weight after the third day was about 20 gm. making a total average gain of 140 gm. while in the hospital, so that three fourths of the infants left the hospital on the tenth day with an average weight of 100 gm. less than the birth weight.

Stools.—There is a great diversity of opinion among authorities as to the normal number of stools of infants during the first weeks. The number, according to different observers, varies from two to six. In our cases the stools averaged less than two per day.

In several infants who were being overfed for metabolism work, the stools became frequent and watery whenever the quantity of milk in twenty-four hours began to approximate 100 calories per kilogram. One of these cases was particularly instructive:

Baby Anderson, birth weight, 3,580 gm., was born at 7 p. m. and got 30 gm. breast milk that evening. Weights, amount of milk and loss for the first twelve days were as follows:

Day	Weight, Gm.	Milk, Gm.	Gain or Loss in Gm.
2nd	3,530	got 255	gain 50
3rd	3,470	got 290	gain 60
4th	3,600	got 415	gain 130
5th	3,670	got 480	gain 70
6th	3,650	got 540	loss 20
7th	3,750	got 750	gain 100
8th	3,750	got 750	no gain or loss
9th	3,740	got 670	loss 10
10th	3,730	got 775	loss 10
11th	3,710	got 535	loss 20
12th	3,710	got 550	no loss or gain—discharged

This illustrates what happens usually in overfed cases; the infants gain for a while, then, after their tolerance is exceeded, they remain stationary for a time and gradually begin to lose in weight.

These overfed infants were the only ones in which the stools were frequent and exceeded an average of two in the twenty-four hours.

5. Bergman: Ztschr. f. Kinderh., March, 1916.

EVIDENCE THAT SUMMER DIARRHEA IS AN INFECTIOUS ENTERITIS*

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In a previous paper[1] I discussed the various theories which have been proposed to explain the great prevalence of gastro-enteric diseases in infants during the summer. The general conclusion in that study was that the heat theory is inadequate to explain the occurrence of diarrhea during the hot weather, although it may act as a predisposing cause. Excessively hot weather also increases the mortality of infants suffering from digestive disorders.

Three years ago the study was taken up again. The cases were studied from the practitioner's standpoint. Each case was studied carefully in regard to its history and clinical characters. The question at issue was, what kind of cases make up the class which bring about the great mortality of the summer?

First, there is the infant who has been suffering for a long period from digestive disorders, has lingered at the threshold of death, and the sudden appearance of extremely hot weather has served as the last killing factor. The sharp peak in the mortality curve is made up of a large number of these cases.

The second group of cases is made up of young children who are given new articles of diet during the summer, such as cherries, apples, strawberries, plums, green vegetables, peaches, melons, etc. These cases are rarely serious and do not add to the mortality, but increase the number of clinical cases.

A third group embraces infants suffering from acute indigestion due to overfeeding on hot days. These patients have the well known symptoms of fermental diarrhea and rapidly recover under dietetic measures. It is questionable whether these cases are much more frequent in the summer than in the winter.

A fourth group of cases is undoubtedly due to spoilt milk. These occur on very hot days when even the refrigerators and ice boxes have a temperature of 60 F. or more, and all housewives report that their milk and cream are sour. Except in infants whose nutrition is already very low, these cases are rarely serious. Vomiting is the most pronounced symptom in these cases.

Fifth, there is the dysenteric group. The infant is acutely ill, and

* Submitted for publication March 23, 1918.

1. Zahorsky, John: Am. Jour. Dis. Child., 1910, **6**, 289.

remains sick for one or more weeks. The disease is characterized by the passage of mucus, blood and macroscopic pus in the stool. This group is well recognized and need not be discussed at length.

Sixth, summer diarrhea.

For want of another term this name "summer diarrhea" is applied to the principal group of diarrheal diseases which occur during the summer. No doubt it is a composite group.

The characteristic symptoms of summer diarrhea are a sudden, acute onset, usually with fever and toxic symptoms, vomiting and diarrhea. The toxic symptoms, as a rule, disappear in from twenty-four to thirty-six hours (except in very young babies), the fever drops to normal, the infant feels better, but the diarrhea persists for several days; sometimes for several weeks. This persistency of the diarrhea distinguishes the disease from the ordinary fermental diarrhea from overfeeding.

The stools have only one common character, and that is they are thin and watery. The color is often green, but may be brown, yellow or gray. The watery character of the stool is easily recognized when it is freshly drawn from the rectum by a tube. After two or three days the stools become more mushy and on close inspection some mucus or mucopus will be noticed. Blood spots are occasionally observed. The acidity, as a rule, is not high except the first day of the disease, when the administration of milk has not been discontinued. I have never found the acidity in these cases as high as in ordinary fermental diarrhea (for example, after the administration of malt soup, Mellin's food, etc.).

Two years ago it occurred to me that if these cases were really infectious enteritis, some evidence of this infectious process ought to be found in the stools. From pathologic studies it is known that the principal lesions in fatal cases of summer diarrhea are swelling and ulceration of the solitary follicles. If one or more solitary follicles are infected (and it is reasonable to assume that any bacteria which enter the mucous membrane would be conveyed to the adjacent lymphoid mass), the pathologic process would be similar to that occurring in the tonsil. There would be hyperemia, swelling, and finally an extrusion of the offending micro-organisms into the intestine, accompanied by leukocytes and lymphoid cells. These leukocytes and lymphoid cells ought to be found in the stools.

I began the study of the stools two years ago, but in this report the cases are limited to those observed in private practice in St. Louis in the summer of 1917.

The technic used was as follows:

A large catheter was introduced into the rectum. In the early stage of most cases the stool readily flowed through the catheter into a

vessel. As mentioned, the stools have a variety of color, but the fluid character is marked. With a splinter of wood a small particle of this stool is mixed with 2 drops of water on a slide. It is examined under the microscope with low power.

In the vast majority of cases the field will show hundreds of leukocytes and round cells.

I have provisionally adopted the following rule in designating the amount of pus in the stool. If more than 100 cells are present, it is called pus index 100. If there is a less number of cells they are designated by approximately the number of cells counted in one field. Thus, if only 30 cells are seen, it is pus index 30. If less than 5 leukocytes are observed the pus index is zero and an inflammatory enteritis is not confirmed.

When the stools become thicker, a small mass of stool, or, if possible, a lump of mucus is mixed with the water on a slide and the cells are observed and counted as before.

Dr. J. L. Swarts, who is studying these cases with me, will report on the type of cells in a later paper.

Here I wish to emphasize that in all severe, toxic, or protracted cases of summer diarrhea in 1917, pus was demonstrable in the stools. The evidence so far goes to show that these cases are due to an infection of the solitary follicles in the upper part of the colon or the ileum. The conclusion is based on the clinical axiom that the presence of pus cells indicates an infectious process.

During the summer of 1917 we examined the stools of 85 infants suffering with diarrhea. Of these, only 12 showed macroscopic pus and blood, symptoms of dysentery. In 7 cases pus was detected only by the most careful inspection. In 53 cases pus could be found only with the microscope (See Table).

Six cases are herewith reported in detail.

CASE 1.—D. S., girl, aged 7 months. She was naturally fed for two months, when the mother's milk failed. Since then the infant has been fed on raw certified milk and thrived. At present (June 26, 1917) her food consists of 4 ounces of milk, 2 ounces of barley water, and 4 per cent. milk sugar added. She has had diarrhea for one week—eight to ten stools daily. The trouble was traced to some ice cream which had been given to the baby at a picnic. No fever has been noticed.

The baby is well nourished; skin feels dry; breathing normal; rectal temperature, 100.2 F. Physical examination otherwise negative. The stool, obtained with catheter, consists of limpid green water, the consistency of urine; acidity of this fluid, 50. Diluted with equal parts of water and a drop placed under the microscope, it shows a solid field of corpuscles. Pus index 100+.

Diagnosis, enteritis. Treatment, bismuth and rhubarb. Diet, barley water, followed after twenty-four hours by barley water and buttermilk (2 to 1).

June 29. Better; temperature 99.6 F.; stools four or five daily, thin dark, not so watery. Pus index 10. Diet, buttermilk and barley water (1 to 1) with 3 per cent. milk sugar.

Summary of Cases Observed by the Author

No.	Age, Mos.	Sex	Date of Onset	Food	Symptoms of Onset	Fever	No. of Stools	Character of Stools	Pus Index	Febrile Period, Days	Length Illness, Days*
1	7	♀	8/ 6	Raw milk	Vomited	103	15	Watery	100	5	16
2	11	♂	6/27	Boiled milk	Diarrhea	101	5	Watery	15	6	24
3	7	♂	10/ 5	Pasteur. milk	Diarrhea	None	7	Mucous	100	..	10
4	11	♂	10/ 4	Raw milk	Diarrhea	101	9	Watery	100	2	11
5	5	♀	8/ 6	Raw milk	Diarrhea	103	20	Mucous	100	10	35
6	7	♀	9/ 1	Cond. milk	Vomiting	101	5	Watery	100	2	21
7	12	♀	7/ 5	Raw milk	Diarrhea	104	6	Slimy	100	2	5
8	14	♀	6/26	Raw milk	Vomited	None	7	Mucous	50	1	12
9	13	♀	7/12	Mixed	Diarrhea	None	6	Watery	20	..	5
10	14	♂	8/20	Mixed	Diarrhea	None	6	Watery	100	..	6
11	12	♂	8/ 6	Mixed	Diarrhea	None	5	Green	100	..	14
12	9	♂	8/ 2	Cond. milk	Diarrhea	100	4	Mucous	10	..	20
13	16	♂	9/ 5	Mixed	Diarrhea	100	8	Mucous	100	2	10
14	6	♂	9/ 6	Raw milk	Diarrhea	102	7	Mucous	100	5	14
15	1	♂	8/25	Cond. milk	Diarrhea	None	5	Green	15	..	..
16	17	♂	9/ 1	Mixed	Diarrhea	None	7	Mucous	100	..	14
17	21	♀	8/ 1	Mixed	Diarrhea	101	10	Watery	50	7	26
18	8	♀	8/ 2	Human	Diarrhea	None	5	Green	20	..	7
19	6	♂	7/ 1	Boiled milk	Diarrhea	None	7	Watery	10	..	5
20	3	♂	8/16	Raw milk	Diarrhea	None	5	Watery	50	..	13
21	5	♂	9/ 7	Boiled milk	Diarrhea	103	8	Watery	20	2	13
22	8	♂	8/23	.....	Diarrhea	None	..	Watery	30	..	20
23	7	♂	8/ 6	Human	Fever	...	..	Loose	20	6	..
24	1	♀	6/14	Mellin's	Diarrhea	...	7	Watery	5	..	21
25	2	♂	8/ 4	Mixed	Diarrhea	None	5	Thin	5	..	3
26	18	♀	8/ 3	Mixed	Fever	100	7	.....	10	..	3
27	15	♂	8/10	Mixed	Fever	...	15	Pus, Mucous	100	5	15
28	15	♀	8/17	Mixed	Vomiting	102	6	Watery	100	2	9
29	2	♂	9/15	Mellin's	Diarrhea	None	6	Watery	100	..	10
30	10	♀	9/20	Raw milk	Fever	102	10	Bloody	100	7	13
31	7	♂	9/ 6	Raw milk	Diarrhea	None	6	Mucous	100	..	16
32	24	♂	9/ 6	Raw milk	Diarrhea	103	5	Blood, Mucous	100	2	9
33	12	♀	8/ 5	Raw milk	Fever	101	10	Watery	100	2	9
34	24	♂	7/	Mixed	Slight fever	...	..	Blood, Mucous	100	1	7
35	25	♂	8/ 8	Mixed	Anemia	102	5	Mucous	20	10	..
36	3	♀	8/31	Boiled milk	Diarrhea	...	7	Watery	100	..	8
37	2	♀	9/ 7	Human	Colic	...	2	Mucous	5	..	..
38	2	♂	9/ 7	Raw milk	Colic	...	2	Green	5	..	..
39	3	♀	9/12	Malted milk	Diarrhea	None	..	Blood, Green	100	..	6
40	14	♀	7/24	Mixed	Vomiting and Diarrhea	100	8	Mucous	100	..	14
41	1	♀	6/15	Human	Diarrhea	100	17	Green	100	4	12
42	4	♂	8/	Raw milk	Diarrhea	101	5	Mucous	10	..	7
43	1	♀	8/12	Human	Diarrhea	...	5	Green watery	20	..	4

* All cases terminated in recovery except Cases 84 and 85, in which the patients died.

SUMMARY OF CASES OBSERVED BY THE AUTHOR—(*Continued*)

No.	Age, Mos.	Sex	Date of Onset	Food	Symptoms of Onset	Fever	Stools No. of	of Stools Character	Index Pus	Period, Febrile Days	Illness, Length Days*
44	5	♂	9/20	Raw milk	Diarrhea	...	6	Mucous	10	..	6
45	1	♀	8/23	Human	Diarrhea	...	7	Green	100	..	15
46	4	♂	.....	Mixed	Diarrhea	None	5	Green	20	..	16
47	4	♂	10/ 3	Raw milk	Vomiting and Diarrhea	None	7	Watery	15	..	8
48	22	♂	8/22	Mixed	Diarrhea	103	12	Bloody, Mucous	100	2	17
49	10	♀	8/ 1	Mixed	Diarrhea	101	8	Yellow	25	2	..
50	12	♀	8/25	Mixed	Vomiting	100	20	Brown, Watery	100	1	..
51	9	♂	9/ 7	Raw milk	Diarrhea	None	10	Liquid, Green	100	..	8
52	11	♀	6/ 3	Raw milk	Diarrhea	None	8	Watery	20	..	10
53	11	♀	8/20	Mixed	Diarrhea	None	6	Mucous	100	..	5
54	12	♂	8/ 3	Mixed	Fever	100	8	Mucous	100	1	6
55	9	♂	7/10	Human	Fever	102	6	Green, Mucous	100	..	20
56	5	♀	6/ 7	Boiled milk	Diarrhea	None	5	Watery	10	..	3
57	7	♀	8/29	Raw milk	Diarrhea	101	5	Watery	50	2	7
58	7	♂	7/ 7	Raw milk	Vomiting and Fever	102	14	Mucous	50	10	12
59	3	♀	7/16	Boiled milk	Colic	None	6	Mucous	20	..	14
60	24	♂	10/ 2	Mixed	Diarrhea	None	12	Watery	100	..	30
61	14	♂	9/12	Buttermilk	Diarrhea	None	8	Watery	50	..	7
62	1	♂	10/	Human	Diarrhea	None	7	Green	100	..	7
63	15	♂	7/ 8	Raw milk	Diarrhea	99	6	Green	50	..	21
64	9	♀	8/10	Boiled milk	Diarrhea	None	8	Green	..	..	7
65	21	♂	6/16	Boiled milk	Diarrhea	None	4	Mucous	20	..	14
66	13	♀	8/25	Mixed	Diarrhea	None	3	Thin	20	..	7
67	23	♂	8/24	Mixed	Diarrhea	99	4	Thin	5	..	10
68	7	♀	6/25	Human	Diarrhea	101	8	Green	100	..	20
69	27	♀	8/ 1	Mixed	Fever	103	7	Mucous	100	..	9
70	4	♂	10/ 4	Raw milk	Diarrhea	None	5	Watery	10	..	8
71	3	♂	7/18	Boiled milk	Diarrhea	None	9	Watery	100	..	10
72	12	♀	8/28	Boiled milk	Vomiting	101	12	Watery	100	..	15
73	17	♀	7/25	Raw milk	Vomiting and Diarrhea	100	10	Watery	50	1	5
74	12	♀	7/10	Mixed	Diarrhea	None	10	Watery	100	..	7
75	7	♂	8/ 9	Cond. milk	Diarrhea	None	14	Watery	100	..	16
76	12	♀	8/25	Mixed	Diarrhea	None	11	Green, Mucous	100	..	11
77	17	♀	7/25	Mixed	Fever	None	12	Green, Blood	100	..	21
78	24	♀	8/13	Mixed	Fever	99	11	Mucous, Blood	100	..	7
79	24	♀	7/10	Mixed	Fever	104	15	Mucous	100	5	20
80	5	♂	7/16	Buttermilk	Fever	100	6	Yellow, Watery	50	1	25
81	26	♂	6/18	Mixed	Fever	101	10	Green	100	1	22
82	20	♂	8/16	Mixed	Diarrhea	None	8	Mucous	30	..	7
83	6	♂	8/10	Boiled milk	Diarrhea	102	7	Mucous	100	5	12
84	9	♀	6/10	Human	Fever	105	25	Blood, Mucous	100	3	3
85	17	♀	6/ 5	Mixed	Fever	103	20	Blood, Mucous	100	7	7

July 4. Two or three stools daily; restless; stools normal; seems hungry; weight 6,825 gm. Treatment, 6 drops paregoric twice a day. Diet, buttermilk and barley water (3 to 2), with milk sugar.

July 20. Very restless; spits up; had a chill today followed by high fever; Urine obtained in the evening full of pus corpuscles. Diagnosis, pyelitis. Temperature 105 F. Treatment, alkalies.

July 31. High, irregular fever (101 to 105 F.) for eleven days; urine almost solid with pus cells; bowels loose again. Has been on dextrinized cereal, sweet milk and cocoa during the last week. Treatment, alkalies; weight 6,356 gm.

August 4. Much better; no fever; looks very pale; weight 6,290 gm. Treatment, hexamethylenamin.

August 11. No fever for several days; urine still contains much pus; very constipated; weight 6,790 gm. Treatment, alkalies. Diet, milk and barley water sweetened with honey, bread and crackers.

September 13. Suffering with a cough and cold in the head; had high fever last night; diarrhea began again; stools watery. Pus index 100. Mucus in the stools; weight 7,230 gm. Treatment, camphor and rhubarb. Diet, barley water, to which milk should be slowly added.

September 20. Perfectly well.

CASE 2.—D. S., girl, aged 1 year; bottle fed since birth. During the previous two months she was fed on malted milk, supplemented with cereals and soup. She was put on boiled milk with flour water.

August 10. She did well for two weeks, when a diarrhea started. The father had given her ice cream. Stool thin and watery. Pus index 50. No fever. Treatment, rhubarb.

August 27. No change; nine stools in twenty-four hours; no fever; is taking one third milk and two thirds barley water; bismuth given.

August 29. Stools still very loose; brownish in color; vomited twice; slight fever during the night. Temperature 100 F. Pus index 100. Diet, barley water; bismuth; paregoric given. The baby did not return.

CASE 3.—T. H., girl, aged 2 months. The baby had been fed on raw milk, water and Mellin's food and lost in weight. When seen (August 30) had no fever; buttocks irritated; seemed hungry; no fever. Diet, baked flour and milk.

September 4. Stools twice a day; stools rather thin; gained 4 ounces; restless; same diet.

September 8. Liquid, frequent greenish stools; severe proctitis. Temperature 98.6 F.; buttocks scalded. Pus index 100 + +. Diet, casein-buttermilk.

September 10. Four stools daily; some mucus. Pus index 20. Stools mushy; no gain in weight. Add dextrimaltose.

September 15. Temperature 99.4 F. Stools yellow, mushy. Pus index 20. Weight 9 pounds 14 ounces.

September 17. Seems well; weight 9 pounds 14 ounces.

CASE 4.—R. A., girl, aged 7 months; seen first Aug. 8, 1916. The infant was naturally fed four weeks, then placed on dextrinized flour and cow's milk. She has had attacks of diarrhea all summer. Mother boils the milk when the bowels are loose and gives the milk raw when she becomes constipated. Certified milk is used. Diarrhea began again two days and fever one day before being seen.

Baby thin, but has good color; skin elastic; temperature 102.6 F.; respiration slightly hurried, not deep; stools thin, watery, no blood; microscopically full of pus. Pus index 100 +. Diagnosis, enterocolitis. Treatment, alkalies, magnesia, rhubarb. Diet, barley water for twelve hours, then buttermilk and barley water, equal parts.

August 9. Looks about the same. Temperature 101.4 F.; respiration normal; eyes bright. Tannin given. Diet, barley water and buttermilk.

August 11. Stools very loose, twelve to fifteen daily; high fever at night; temperature 102.5; weight 5,760 gm.; eyes not so bright; skin elastic. Rectal injections of buttermilk whey given twice a day. Diet, barley water mixed with dextrinized flour; two feedings of Mellin's food daily; stool still full of pus cells.

August 13. Very much better; temperature 99.1 F.; looks brighter; two stools today; vomited twice yesterday; weight 5,790 gm. Milk was tried but was vomited.

August 17. Looks well; constipated. Pus index 10. Weight 5,760 gm. Salicylic acid and rhubarb given; diet the same.

August 22. Weight 5,700 gm.; two stools daily; no pus in the stool. Diet, roasted flour, to which a little milk is to be added.

August 30. Seems well; weight 5,900 gm.; stools normal. Diet, roasted flour, milk and sugar; orange juice.

Case 5.—V. B., girl, aged 14 months, was seen first Aug. 17, 1917. Was naturally fed a few weeks only, then given condensed milk and barley water. In October, 1916, she had an attack of diarrhea which continued more or less for three weeks. Recovered under the use of buttermilk and dextrinized flour. Had two attacks of acute respiratory infections last winter. She has been fed cereals and certified milk. Began to have frequent movements two weeks prior to being seen; was put on barley water; looseness of the bowels continued; stools green and watery. A few days later she developed cough and high fever. The temperature ranged from 103 to 105 F. the last two days.

Physical examination of the chest showed diminished breathing in the left lung, and a few fine râles.

Examination of the urine showed an enormous number of pus cells. Two days later some of the stool was drawn with a catheter and was found full of pus cells. Pus index 100. Diagnosis, pneumonia, pyelitis, enteritis.

August 25. Fever dropped to normal; left lower lobe consolidated; stools and urine still contain pus; hexamethylenamin and aromatic syrup of rhubarb given. Diet, barley water and buttermilk.

The baby slowly recovered.

Case 6.—F. J. B., girl, aged 14 months.

June 27, 1917. Four days ago she became sick with vomiting, followed by diarrhea. She has been fed on certified milk, supplemented with cereals, broth and eggs. No other milk or ice cream has been given. She had fever the first twenty-four hours, none apparently since then; six to seven stools daily, slimy and watery in character.

Examination showed a small baby, fairly well nourished; temperature 99 F.; physical examination otherwise negative.

The stool obtained with a catheter was soft yellow, containing some fatty curds. Stool diluted one fourth contained from 30 to 40 pus cells to each field. Diagnosis, enteritis.

Diet, cereals with barley water and milk sugar. Sodium bicarbonate, magnesia, rhubarb given.

June 29. Feels much better; three stools today; temperature normal; stool firm; pus index 20. Diet, the same; bismuth subnitrate given.

July 3. One black stool daily; seems very hungry; weight 8,170 gm. Aromatic rhubarb given. Diet, ½ pint of milk added to cereals daily.

July 12. Stools firm; good appetite; two or three stools daily; weight 8,210 gm.; temperature normal. Tincture quassiae and lactic acid given.

July 20. Stools normal; two or three stools daily, slightly sour. The infant now gets 1½ pints of milk daily; weight 8,520 gm.

July 30. Stools good; sleeps well; one or two stools daily; feels fine; weight 8,710 gm. Diet, cereals, milk, fruit and vegetables.

The summer of 1917 was unusually cool, and no connection could be traced between atmospheric conditions and the onset of the diarrhea. Three cases ended fatally, all showed pus in the stool. Two of these cases were very severe forms of membranous dysentery and pus was passed by the teaspoonful every few minutes. In the majority of cases the infection could be traced to unboiled milk or ice cream. In three cases the source of infection could not be determined. Flies seem to have been factors in two cases. Evidence of contagion was found in three instances.

CONCLUSIONS

The summer diarrhea in St. Louis in 1917 was an inflammatory enteritis of infectious origin.

The examination of the stool for pus corpuscles is a valuable clinical aid in diagnosis.

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LYMPHATIC DISEASE IN CHILDREN SIMULATING APPENDICITIS

WITH A REPORT OF SEVEN CASES *

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In the past few weeks there have come to operation several cases of suspected appendicitis in children, but the exploration disclosed very unexpected and strikingly similar features. These were rather unusual, and in studying the records of other children who have been operated on recently in the surgical clinic, I found seven cases with the same unusual findings. In this article I shall review briefly the records of these cases, pointing out the prominent features which seem to characterize this particular syndrome.

REPORT OF CASES

CASE 1.—L. S., aged 8, was first seen in the surgical clinic Nov. 24, 1916. He had been brought to the hospital because of attacks of abdominal pain. The family history and past personal history were wholly negative. The present illness began about a year before coming to the hospital. This trouble consisted of a series of attacks of pain in the abdomen, aggravated by walking or by climbing stairs. The pain would begin each morning when the boy awoke. Examination at the hospital showed slight abdominal tenderness, not well localized. The laboratory findings were all normal. The Wassermann test was negative. The roentgenographer reported "a first degree ileal residue and a constricting zone across the cecum suggestive of adhesions and indirectly of appendicitis." A diagnosis of recurring appendicitis was made, and operation advised. At exploration, Nov. 27, 1916, the appendix was found free, long, and hypertrophic. The mesenteric and retroperitoneal lymph glands were all enlarged. The appendix and one gland were removed for microscopic examination. The pathologic report was as follows: "Appendix shows very marked lymphoid hyperplasia, no active inflammation. The swelling of the lymphoid tissue is such that the lumen is partially obliterated. The lymph gland shows also a marked lymphoid hyperplasia. This patient should be examined for enlarged glands or other evidence of lymphatic struma or hyperplasia. Our diagnosis is lymphatic struma." We were interested to learn the result of our operation, and two weeks ago I wrote to the home physician, who reported that the patient was "entirely cured and nas had no further trouble," now fifteen months after operation.

CASE 2.—S. C., aged 11, was first seen Feb. 9, 1917. He also had come because of attacks of abdominal pain. The family and personal history were negative. "His attacks began in July, 1916, with sharp colicky pains in the abdomen, lasting for several minutes. He was nauseated but did not vomit.

* Submitted for publication April 2, 1918.
* From the Department of Surgery, University Hospital.
* Read before the Clinical Society of the University of Michigan, March 6, 1918.

These pains came on several times a day and were relieved by bending over or by the application of cold. The patient had become constipated in the last year. The latest attack, which began three weeks before entering the hospital, was the most severe. This started as a generalized pain in the abdomen, which soon localized in the right side. There was vomiting but no fever. Examination showed very little except tenderness on palpation in the lower right quadrant of the abdomen." The laboratory findings were all normal; Wassermann test on the blood, negative. Operation, Feb. 14, 1917, disclosed a long free appendix, but the lymph glands in the meso-appendix and the other mesenteric nodes were all enlarged. The appendix and one gland were removed. The pathologist reported, "Lymphoid hyperplasia and chronic lymphadenitis."

CASE 3.—J. S., aged 14. This boy, the oldest of my cases, was examined July 13, 1917. He complained of "stomachache." The family history was negative, and the personal history was negative except for scarlet fever in April, 1917.

The present illness began a year before coming to the hospital. The boy gradually noticed a dull aching pain in the abdomen, which occasionally became sharp and severe. At first these pains came on at weekly intervals, but had come to be a daily occurrence. The pain came on without any apparent cause and was localized definitely in McBurney's area. Nausea was present but no vomiting. The boy would relieve the pain by doubling over. Examination showed nothing abnormal save for very definite tenderness to the right of and below the umbilicus. The laboratory tests were all normal; Wassermann negative. The roentgen ray showed a gastric and ileal residue and was diagnosed chronic appendicitis.

At operation, July 16, 1917, the appendix was found to be very long and markedly thickened. All the lymph glands in the mesentery and the retroperitoneal nodes were enormously enlarged. The appendix and two glands were removed. Microscopic examination showed "Lymphoid hyperplasia of appendix and lymph glands."

CASE 4.—E. S., aged 12, was referred from the pediatric clinic, March 13, 1917. The family history and past personal history were negative. The patient came because of attacks of pain in the right side of the abdomen which recurred at one and two week intervals during the previous year. These attacks were all similar in nature—pain in the right lower quadrant of the abdomen, followed by nausea, vomiting and constipation. The pain did not radiate and there was no fever. The patient was sick for two or three days in each attack. Examination at the hospital was entirely negative, except for some muscle spasm and tenderness in the right lower quadrant. The laboratory findings were negative, as was the Wassermann test. The gastro-intestinal roentgen-ray examination was also negative.

The patient was operated on March 15, 1917. A long, free appendix was removed. All the mesenteric lymph glands were enlarged. No other pathology was found. The pathologic report was very terse: "Lymphoid hyperplasia."

CASE 5.—V. G., aged 7, came to the hospital because of pain in the right lower abdomen and was referred to the surgical department Dec. 10, 1917. The family history was negative. At 4 weeks of age and at 2 years, the patient had an attack of "heart trouble" but there was no evidence of intestinal trouble then. The present trouble began about a year prior to admission with pain in the right lower abdomen which lasted four or five days; no fever, no vomiting, no constipation. The child has been troubled with this pain off and on ever since. About the middle of November the girl left school because the ache was getting more and more severe.

Examination on entrance showed the posterior cervical glands slightly palpable. There was slight tenderness in the right lower abdomen, and the stomach was somewhat dilated. Blood, urine, and stomach examinations were normal; Wassermann negative. The roentgen ray showed a gastric and an ileal hypomotility. The roentgenographer said he believed that the findings justified a diagnosis of chronic appendicitis.

At operation, Dec. 11, 1917, the appendix was found to be long and hypertrophied. The distal half was free but there were some adhesions near the base. The mesenteric lymph nodes in the neighborhood, extending from the terminal ileum, appendix, and cecum were all enlarged. The appendix was removed and the pathologist reported, "No inflammation." To determine what if any effect removal of the appendix might have in changing the motility picture, a second roentgenographic examination was made fifteen days after the operation and everything was found to clear normally. The patient felt well.

CASE 6.—M. S., aged 11, entered the surgical clinic as an emergency case, Jan. 22, 1918, because of acute pain in the abdomen. The family and past personal history were negative. The present illness began in January, 1916, with an attack of pain in the right abdomen so severe that she was doubled up and could neither lie down nor stand up. The patient vomited and complained of a severe headache and constipation. The attack lasted two or three days. In the previous two years she had several minor attacks similar in nature. The last attack began three days before coming to the hospital, with severe pain in the right lower quadrant of the abdomen, headache but no vomiting.

When examined on entrance there was found marked tenderness and muscle spasm in the right abdomen; no evidence of adenopathy. The temperature was 99 F. Blood count and urine examination were normal; Wassermann negative. The patient was operated on the next day and a long, free appendix was found. The mesenteric nodes were all enlarged. The appendix and two glands were removed. The pathologic report was, "Lymphoid hyperplasia in lymph gland and appendix."

CASE 7.—S. D., aged 4 years, the youngest patient in our series, entered the surgical clinic Jan. 21, 1918, because of convulsions, epileptiform in type. The family and personal history were negative. The convulsions began the last of May, 1917. There were no prodromal signs or symptoms. One night, without warning, the boy had a generalized convulsion. The next day he was tired out. These attacks recurred at frequent intervals and were associated with severe constipation, nausea, vomiting, headaches and some abdominal pain. The patient had had osteopathic treatments (probably massage) which seemed to regulate his bowels, and just so long as he took the treatments and the bowels moved regularly, there were no attacks; but as soon as the treatments were discontinued, the constipation returned and the attacks recurred.

The physical examination, laboratory tests, and Wassermann were all negative. The gastro-intestinal roentgenogram showed gastric and jejunal hypomotility. Diagnosis, chronic appendicitis.

Jan. 27, 1918, an exploratory operation was performed. The appendix was found rather thickened but could not definitely be called pathologic. Very large lymph glands extended away from the base of the appendix and were found especially at the ileocecal junction. The lymph glands were enlarged, also, throughout the mesentery and retroperitoneal region. The appendix and several glands were removed. The pathologic report showed, "Lymphoid hyperplasia of the appendix. No inflammation. The lymph nodes showed lymphoid hyperplasia; large germ centers; exhaustion of the germ centers suggestive of lymphatic constitution." Sixteen days after the operation a second roentgenogram was taken to compare with the pre-operative plates. "The striking feature is that the hypomotility previously noted has entirely disappeared. Motility now normal."

DISCUSSION

From the foregoing digest of cases certain unusual, outstanding features impress themselves.

All these symptoms occurred in children under puberty, or who had just reached puberty. The oldest was a boy of 14 who gave evidence of rather retarded development.

In no case was there found anything in the family history to suggest an inheritance.

All presented a symptom syndrome suggestive of recurring attacks of appendicitis—not exactly a typical, textbook picture, but each presenting almost the same features and omitting others which are usually in evidence in a true infectious appendicitis. Thus, in each, the abdominal pain was the most prominent symptom, coming on in attacks lasting from a few hours to a couple of days. Each complained of nausea which in some instances led to vomiting. Constipation was a frequent complaint. Usually there was headache. In all, the pain was more or less localized in the right lower abdomen, and did not radiate.

The clinical and laboratory findings were all strikingly similar. No patient had fever; none presented a leukocytosis; urine and blood tests were in every case normal. A roentgen-ray examination was made in five of the cases and in four of the five there was a definite ileal hypomotility. The Wassermann was negative in all. In no case was any other pathology discovered than abdominal tenderness in McBurney's region. In every case the history and findings were more like appendiceal trouble than any other disease with which we were familiar, and in four instances the roengenologist, from his standpoint, agreed with us. Yet in each and every case the pathologist reports simply and succinctly, "lymphoid hyperplasia." In two cases he amplifies this to suggest the possibility of a lymphatic constitution or lymphatism.

In trying to relate this syndrome to other known diseases, two were found to approach it:

1. Glandular fever or "Pfeiffer's disease." This is an infectious disease of children characterized by swelling and tenderness of the lymph glands, usually in the neck. In a few cases the axillary, inguinal, and sometimes the mesenteric glands are involved. The first symptoms are those of any acute infection—headache, nausea, pain in the neck and abdomen, fever to 103 F., with enlargement of the glands appearing on the second or third day. But our patients had no fever and no palpable swelling and tenderness of the superficial glands, which findings are so constant in Pfeiffer's disease. We are therefore inclined to rule out this disease.

2. Status lymphaticus. This is labeled as "a rare condition, met with chiefly in children, in which the lymph glands and lymphoid tissues throughout the body are in a state of hyperplasia. Pharyngeal thoracic and abdominal groups are most frequently affected, the cervical, axillary and inguinal glands less commonly, but may show slight enlargements." This is quite in keeping with our findings. "The lymphatic structures of the alimentary tract, the tissue of the tonsils and adenoid structures of the upper pharynx, the solitary and agminated follicles of the small and large intestines are usually much enlarged. The hyperplasia of the intestinal lymph structures may be most remarkable, the individual glands standing out like peas." This characterization of status lymphaticus is like our cases.

In no case were we able to determine thymic enlargement. One case suggests this in the early heart attacks, which were characterized by dyspnea, cyanosis and finally almost complete apnea, where death was momentarily expected for several days. Another case, in which convulsions were present, also suggests the possibility of a true lymphatism. We cannot but feel that in some way our cases are instances of a degree of lymphatic constitution which fortunately are not of an aggravated type and have not resulted in the so-called "thymic death."

The question naturally arises, is the appendix at fault? What results may we expect following its removal?

Attention was centered in the appendix because all the signs, symptoms, and clinical evidence led us to this member as the offender. Yet how it produced the symptoms cannot be said with any degree of assurance. We cannot yet explain lymphatism. Why the hyperplasia of these lymphatic structures? Is it due to a low grade, chronic infection, or is it a case of persistent intoxication? In these cases I believe that, due to the hyperplasia of the rich lymphoid tissue in the appendix, the lumen is obstructed. This was seen in two of our cases, and concretions were found at operation. We know that obstruction of an inflammatory nature, with retention of contents, can give us definite attacks of appendiceal colic. So I am inclined to interpret these symptoms as the result of a like process, but due to a definite lymphoid hyperplasia. The obstruction then gives rise to the colic and the reflex interference with the intestinal motility.

What result may we hope for? For eliminating the symptom complex which brings these patients to the hospital, it is rather encouraging. One patient has been well for fifteen months. I had hoped to be able to give definite reports on others, but I have failed to receive answers to the questionnaires which I sent out. Two patients were roentgenographed just before leaving the hospital, and from a roentgenographic

point of view, showed striking improvement. What effect removal of the appendix will have on the general glandular enlargement cannot as yet be predicted. In favorable cases I would expect atrophic changes in the thymus and lymphoid structures to take place as the child grows older; and the patient may outgrow all evidence of this affection.

This is the outcome I would like to expect for these children, appendectomy to relieve the immediate and severe manifestations of the disease, followed by ultimate disappearance of the disease through natural retrograde changes.

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